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Pr9904 - Specification for Pressure Pipe Construction

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References	Refer to Appendix B of this document

Version Review

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3.0	B Maule	A. Schoenmaker	27/03/2017	15.4 Water Quality Commissioning and Testing (Water Mains Only) - updated
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8.0	B. Maule	Endorsed by IS&PA Committee Approved G. Burnett	28/10/2019	5.13 Existing Coated Pipes (Hazardous Substances) – new 8.15 Under Pressure Cut-in Connections – update 9.1 Working Safely with MSCL Coal Tar Coated Pipes - new
9.0	L. Bryson	N/A	N/A	23/04/2021: Minor amendment to replace obsolete reference Pr9086 - Pressure Testing of Sewer Mains Work Instruction with Pr9085 - Pressure Testing of Sewer Rising and Gravity Mains Work Instruction (docs consolidated). Template also updated.
10.0	R. Stringfellow	Endorsed by IS&PA Committee 28/10/2021 Approved by G. West	15/11/2021	Document Owner update from Manager Capital Delivery to Head of Asset Management 3.4.4 *Work Health and Safety Regulation 2011* (Qld) ref. 5.1.3 All polyethylene pipe DN315 or larger shall be supplied with a "Certificate of Compliance". 5.16.2 Screw-on flanges. 7.19.5 minimises installation depth.
11.0	A. White RTO Link Resources (for MUTCD only)	C. Bemis A/Head of Asset Management	28/10/2022	Periodic review: 3.2 – rename Qld Building and Service Authority Act to Qld Building and Construction Commission Act 5.1.3 – Updated quality requirements 5.2 – reword to clarify requirements 5.5.1 – update MUTCD reference with QLD Guide to Temporary Traffic Management 5.12 – Add ALL overhead 5.19.3 – lifting requirements 5.20 – changes to storage requirements 7.6.5 – Replace DBYD references with Before You Dig Australia (BYDA) as service rebranded.
12.0	A. White	I. Beirne Head of Asset Management	07/12/2022	Insert new 5.20 Welding Session section Re-number remaining clauses after the inserted clause
13.0	A. White	I. Beirne Head of Asset Management	11/01/2023	Remove paragraph clause numbering where not required
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15.0	L. Bryson	N/A	N/A	12/06/2023 Minor amend to update doc reference title for Pr8996.
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17.0	J.Munro Document Control Officer	N/A	N/A	26/09/2023 Minor admin amendment to replace obsolete reference Pr8871 with Pr11211

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1. Purpose

The purpose of this Specification is to define Unitywater's requirements for the construction of pressure pipelines and associated fittings for use in water, recycled water and sewerage pressure mains within Unitywater's network.

These requirements shall also apply to other pressure pipelines associated with the transport of water, sewage and sludge typically found at Unitywater's Sewage Treatment Facilities.

2. Scope

This Specification shall apply to works being constructed directly for Unitywater or other authority or for an owner who will hand over the ownership of the constructed works to a local government or who will retain ownership.

The Specification applies to pressure mains constructed from ductile iron (DI), poly-vinyl chloride (PVC), glass filament reinforced thermosetting plastic (GRP), mild steel (MS), Acrylonitrile Butadiene Styrene (ABS), polyethylene (PE).

3. General Requirements

3.1. General

Pr11034 - Specification for Trunk Water Main Design and Construction Code (TWM Code) defines Unitywater's requirements the design, construction, commissioning, and handover for any new Trunk Water Mains to be located within Unitywater's water network.

This specification (Pr9904) should be read in conjunction with Pr11034 - Specification for Trunk Water Main Design and Construction Code (the TWM Code).

3.2. Information to be supplied by the Manufacturer

Where a pipe, fitting, valve or other items are to be manufactured, whose dimensions and tolerances are not detailed in this Specification or the references given in Appendix B of this Specification, the manufacturer shall submit for approval a complete description of the proposed item. The description shall include drawings showing general detail, overall dimensions and detailed dimensions of component parts including fits and tolerances. The composition of the materials to be used in the manufacture of the component parts shall also be submitted.

If a manufacturer proposes to use any material not specifically mentioned herein or any material with composition or properties differing from those covered in this specification or to apply any special treatment or process to any material in order thereby to provide any extra strength, durability or any other desirable quality, the manufacturer shall supply a complete specification of such material, treatment or process and shall obtain the approval of the Superintendent before utilisation of the material, treatment or process.

As part of the Contractor's Quality Management Plan, all polyethylene pipe DN315 or larger shall be supplied with a "Certificate of Compliance" from the pipe manufacturer confirming compliance with; AS/NZS 4130 Polyethylene (PE) pipes for pressure applications, AS/NZS 4131 Polyethylene compounds, PIPA POP004 Polyethylene pipe and fittings compounds. The certificate shall demonstrate compliance with AS/NZS 4130 and AS/NZS4131 including but not limited to:

a) Product Specification sheets.
b) Product Certificate or Analysis (for all batches).
c) QA Production Performance sheets.
d) OIT Testing results, including details on Thermal Stability in relation to pipe size.

e) Extrusion Report sheets, including details on Speed, melt temperature control, extruder throughput.

f) Extrusion Line checklist including wall thickness tolerances.

g) Ovality Check sheets.

3.3. Information to be supplied to the Contractor

All Relevant drawings and project specifications required to undertake by the Contactor to construct the works to the Superintendents requirements will be provided as part of the Project Tender documentation.

Such information will normally be in the form of key or layout plans, detail plans, longitudinal sections of pipelines, standard drawings, results of soil investigations at the works site and any other information which may be considered relevant.

The Contractor shall satisfy themselves that the information supplied by the Superintendent is of sufficient detail to fully complete the works. If the Contractor determines that additional information is required, then the Contractor must submit a RFI to the Superintendent requesting the required information.

3.4. Temporary Works

The contractor shall provide to the Superintendent, RPEQ certification for all Temporary Works. These works can include, but are not limited to, Sewage Pumping Station Bypass pumping arrangements, Non-standard thrust restraints.

Where the Superintendent accepts that Water Supply projects can employ a temporary bypass system, this arrangement shall be in accordance with Pr10179 – Specification for Water Supply Temporary bypass.

3.5. Setting Out

The Superintendent shall supply to the Contractor sufficient information to accurately locate the works.

In the case of pipelines the Superintendent will supply the Contractor with sufficient information to locate the centreline and depth.

In the case of other works the Superintendent will establish datum lines from which the Contractor can locate structures and interconnecting pipework. The Contractor will be supplied with layout plans, structure details and the diameter, level, length and grade of the pipelines.

In both cases the Contractor will be supplied with a level datum related to conveniently placed Permanent Survey Marks or temporary benchmarks.

The stated origins for the level datum shall be preserved from damage or interference by the Contractor.

The Contractor shall be responsible for any costs associated with the reinstatement of any Permanent Mark damaged or removed during the progress of the works.

It shall be fundamental to the Contract that the positions of pressure mains in relation to the boundaries of premises and to the improvements thereon shall be maintained unless authorised otherwise by the Superintendent in writing.

The Contractor shall establish offset pegs clear of the immediate working area.

3.6. Traffic Control and Road Signage

All traffic control and road signage shall be in accordance with the approved Traffic Management Plan or approved Traffic Guidance Scheme and the Queensland Guide to Temporary Traffic Management (QGTTM) published by the Queensland Department of Transport and Main Roads.

Traffic control shall ensure at all times the safe passage of vehicles and pedestrians through and around the site and physical separation of traffic and pedestrians from construction activities.

3.7. Real Property Survey Pegs

The Contractor shall mark all real property survey pegs, including easement pegs, by a 600 mm high painted stake before work commences on the adjacent pipeline. The Contractor shall take full responsibility for the maintenance of such pegs once he commences work on the contract and if any are disturbed he shall arrange replacement by a licensed surveyor at his own expense.

3.8. Care for and Relocation of Existing Fences

Fences, other than those specifically noted for removal, shall be maintained at all times with special care taken to prevent straying of stock if grazing is carried out on adjoining lands.

If fences are required to be cut or moved, the Contractor shall erect temporary fences for stock containment as agreed with the property owner or as directed by the Superintendent.

Where fences are to be cut for access, wire shall be drawn tight to end posts, suitably strutted and suitable gates provided, if directed, for closure after working hours or when no work is in hand on the site.

Any fence cut or removed during the execution of work shall be replaced and reinstated to its original alignment unless otherwise directed by the Superintendent. It is the Contractor's responsibility to ensure that the fence is located correctly.

Any fence, or part thereof, damaged by the Contractor’s works shall be repaired immediately with appropriate materials in consultation with the owner and Superintendent.

Re-erected fencing shall be true to line and posts installed vertically.

No relocated fencing shall be erected to a standard below that which existed prior to relocation.

3.9. Work within Private Property

The Contractor shall confine all work within private property to minimise disturbance. Disturbance within the property shall not extend beyond a 6.0 m wide construction swathe unless agreed otherwise with the Superintendent. If directed by the Superintendent, the Contractor shall erect a temporary barrier fence or marker to define the limits of the construction swathe. Activities outside the limits of the construction swathe shall not be permitted without the expressed permission of the Superintendent.

It is the Contractor's responsibility to give prior notice to private property owners of any construction activities that may affect them or their property. General notification is to occur two weeks prior to commencing these activities and specific notification 48 hours prior to clearing or excavation work. Notwithstanding the above, notification periods and formats shall comply with current legislation.

3.10. Work within Road Reserves

All work within road reserves shall comply with the following:

- Work shall proceed without interruption to traffic and any steps necessary for the protection of the public during construction shall be taken;
- Warning signs, flashing lights and other traffic control devices shall be erected in accordance with the relevant road authority requirements;
- Work which is likely to reduce traffic flow shall be carried out between 9.00 a.m. and 3.00 p.m. only and shall be organised so as to cause minimum disruption to pedestrians and access to adjacent properties; one lane of traffic under 'Shuttle Flow (STOP-SLOW)' control must remain open at all times along all roads;
- Trenches shall not be left open overnight;
- Work shall be carried so as not to detrimentally affect the existing drainage provisions of the roadway.

3.11. Notification of Impact on Adjacent Properties

It is the Contractor's responsibility to give prior notice to private property owners of any construction activities that may affect them or their property. General notification is to occur two weeks prior to commencing these activities and specific notification 48 hours prior to work commencing.

Notification shall be in a form approved by the Superintendent and include the nature and expected duration of impact and both business hours and after hours telephone numbers for the Contractor in the event of difficulties arising.

3.12. Impact on Unitywater Network

It is the Contractors responsibility to advise Unitywater of any impacts that the works will have on or in proximity to Unitywater's infrastructure network.

The Contractor shall give a minimum of twenty-eight (28) days' notice to enable any Unitywater Planned Network Interventions to be assessed and approved.

3.13. Overhead and Underground Services

The Contractor shall note the presence of all overhead and underground services on the works site. Special care shall be taken in the vicinity of electricity services.

The locations of some underground services are indicated on the drawings and are based on information supplied by the respective Authorities where such information is available.

It is emphasised that information supplied regarding these services is tentative only with respect to both details of services shown and the existence of other services not shown.

Neither the Principal nor the Superintendent warrant the completeness or accuracy of the information given and the Contractor is required to make enquiries into the presence and location of underground services with the relevant Authorities.

The attention of the Contractor is drawn to the fact that private underground and overhead services and individual services to premises from public utility mains are not shown on the drawings. For services that are owned by Queensland's Department of Main Roads, contact planroom@tmr.qld.gov.au for locations of DTMR's existing services. For services that are owned by Queensland Rail refer to QR's website: https://www.queenslandrail.com.au/forbusiness/thirdpartyaccess.

The Contractor shall verify the position of each underground service before commencement of excavation. The Contractor shall pre-locate the services as to depth, alignment and extent or size, so as to ensure such services are not adversely affected. Hand excavation may be necessary to close proximity to services until the exact location is determined.

Trenches containing underground services shall be backfilled so that the subgrade is restored to its original state of compaction. Where selected backfill has been placed by other utilities and has had to be removed, it shall be replaced by the same type of selected material. All backfill shall be carefully deposited in the trench and around the utility service in layers and adequately compacted by proper hand rammers and tampers, or by use of effective mechanical equipment.

Extra care shall be taken by the Contractor to re-compact excavations near existing underground pipework, so that foundations of that pipework are restored and more especially when re-compacting in the vicinity of low flexibility pipework.

The Contractor shall be held responsible for any damage caused to existing overhead or underground services. In case of failure or damage, the Contractor shall immediately notify the relevant service provider and arrange for repairs to be undertaken. If there is any delay, the Superintendent will arrange for repairs to be carried out by the Principal or others and the full cost of such repairs shall be borne by the Contractor. If, in the opinion of the Superintendent, the failure or damage causes an emergency situation, then remedial action will be taken by the Principal and the full cost of such action shall be borne by the Contractor.

Only those persons qualified to undertake repairs on the relevant services shall be permitted to perform the work with the prior approval of the service authority.

3.14. Existing Coated Pipes (Hazardous Substances)

The Coating on pipes manufactured prior to the 1990's can contain hazardous materials.

The hazardous materials may be in the form of asbestos, polycyclic aromatic hydrocarbons (PAHs) and/or polychlorinated biphenyls (PCBs).

All coal tar or bitumen wrapped pipe may contain these hazardous materials.

They can be generally categorised as having black wrapping around a steel pipe, however the appearance of the wrapping and how it has been applied may vary. In some circumstances it may appear grey or white if it has been exposed to the sun. Often fibre strands can are visible from either the asbestos in the coating or from synthetic mineral fibres.

When working with coated pipes, proper precautions and procedures must be followed at all times. It is important to correctly identify the type of pipe and the age of its coating before determining the correct steps to take.

Working on pipes with hazardous materials must only be undertaken by personnel accredited with approved training and skills, using the correct equipment and personal protective equipment (PPE).

If it is suspected that the pipe coating is asbestos coal tar enamel or similar bituminous material, inform the site supervisor. (an exclusion zone shall be immediately installed around the area).

Only personnel with the appropriate skills, knowledge, equipment and PPE may enter the exclusion zone.

Contractors undertaking works on these mains shall:

a. Develop and submit a work method statement and job safety (risk) analysis for the specific works to Unitywater.

b. Possess a current license to handle and remove the hazardous material.

c. Carry out works in accordance with OH&S (Asbestos) Regulations.

3.15. Alterations to Public Utility Services

Where it is necessary to carry out alterations to existing overhead or underground services, this work will be arranged by the Contractor unless otherwise specified.

The Contractor shall allow to co-ordinate and work around service authorities where relocations are necessary during the Contract.

The Contractor shall promptly advise the Superintendent of any services affecting the works which were not shown on drawings so that appropriate action can be taken.

3.16. Materials and Workmanship

The Contractor shall supply all the materials required to complete the Contract in accordance with the issued drawings and specifications unless stated otherwise elsewhere in this Contract. The materials supplied shall comply with the relevant Australian Standard.

All materials in contact with drinking water shall comply with the requirements of AS/NZS 4020.

Unless the manufacturer has an approved Quality System in place, all manufactured items shall be inspected and tested at the place of manufacture by the nominated inspecting and testing authority.

The Contractor shall employ experienced workers and tradespersons on all types of work required by the Contract. The standard of work shall be such as to allow the works to be used for their intended purpose over their expected working life. Licensed tradespersons shall be employed on those works governed by statutory regulations.

3.17. Pipes

The pipe materials and their structural requirements shall be as set out in this Specification, SEQ WS&S D&C IPAM list and all applicable drawings. Pipes shall be provided with flexible joints in accordance with the relevant Australian Standard unless otherwise stated.

DICL pipes shall be wrapped with sufficient polyethylene sleeving and sealing tape in accordance with AS 3680. Screw-on flanges should not be subject to a moment force and is not to be used underground unless special provision is made to either fully support the pipe or inclusion of flexible joints.

The Superintendent may carry out tests on the soils and groundwater in which the pipes are to be located. These tests may be used in the selection of pipe materials, their structural requirements and any external protection. The results of any such tests will be made available to the Contractor.

3.18. Pipeline Components

Pipeline fittings, sluice valves, butterfly valves, check valves, spring hydrants, air valves, couplings and valve and hydrant boxes shall comply with the SEQ WS&S D&C IPAM list.

3.19. Branding of Mark Number

Where the documents provide a mark number for the fittings and pipes, then they shall be branded with the mark number by the contractor.

3.20. Materials Transport and Handling

The Contractor shall cart all materials to their appropriate position in the pipeline. This cartage shall include all necessary loading and unloading.

Every care must be taken during loading, stacking, carting and handling of pipes, fittings or pipeline components. On no account shall pipes, fittings or pipeline components be dropped off trucks or allowed to collide one with another when rolled down skids.

The use of chain or wire rope slings or fastenings will not be permitted on pipes unless properly protected with rubber belting. The preferred method of lifting for all pipes over 315mm dia is either vacuum lifting or slings with spacer bars. Damage to any coatings shall be made good in a manner satisfactory to the Superintendent.

When distributing pipes, fittings, valves or other material along streets, roadways or easements, pipes and fittings shall be located in a safe and stable location, secured from movement with wedges. Care must be taken not to cause any blockage or hindrance to drainage or traffic (including pedestrians) of any sort. Safety barriers, warning signs and flashing lights shall be provided as appropriate.

3.21. Welding Session Definition

Unitywater defines a weld session as being welds completed within a single day at one construction site that includes all pipework:

a. Of the same diameter;
b. Same pipe wall thickness (SDR);
c. Same welding machine;
d. Welds undertaken by the same welder on a single site.

Any deviation to the above will create a new welding session.

For example:

a. Multiple welding machines operating on a single site or project, regardless of the pipe sizes and wall thicknesses – each Welding Machine is a separate welding session.
b. Any change to pipe size or wall thickness, even if the same welding machine or Welder.
c. Any change of Welder on the starting welding machine.

d. A change of welding machine due to machine for any reason, despite the pipe size and SDR remaining constant.
e. Relocation of the welding machine further than 350m within the established construction site or to a new site.
f. Any change of welding machine parameters used to weld the pipes.

The contractor must identify all proposed Welding Sessions (where practical) in the Inspection and Test Plan (ITP) of the Quality Management Plan and identify all Hold/Witness points prior to any pipe welding commencing.

3.22. Delivery and Storage

The Contractor shall comply with the National Transport Commissions – Load Restraint Guide 2018 and the manufacturer's instructions for delivery, handling and storage of pipes and fittings. Delivery shall be into stockpiles as close as is practicable to the pipeline route unless specified otherwise. The pipes, fittings and valves shall be securely stacked clear of the ground in a safe, stable and secure location to restrict public access. The Contractor shall provide all cranage, labour and materials necessary to unload and stack in the stockpiles. All damage done to the coating in transit or during unloading and stacking shall be satisfactorily repaired by the Contractor at his own expense to the manufacturer's requirements.

The Contractor must demonstrate that pipes and fittings will be delivered in such quantities and at such times as required to complete the contract without causing any delays. The Contractor shall be responsible for maintaining the stockpiles of pipes and fittings in a safe and tidy manner until such time as they have been inspected and accepted in writing by the Superintendent.

For all poly and non-rigid pipes, the following storage measures shall be adopted:

a. The pipe storage surface must be level and free of stones, branches and other sharp projections.
b. Pipes must be layered and stacked in a way that avoids the risk of damage or permanent deformation.
c. Large thin-walled pipes must be fitted with stiffener rings.
d. Avoid single point or narrow longitudinal supports.
e. Exposure to oil, solvents and other chemicals must be avoided at all times during storage.
f. Stored pipes must not be exposed to the elements more than absolutely necessary (i.e. they should be kept in a covered warehouse).
g. If stored outdoors, (e.g. construction site), they shall be covered for protection against weather (e.g. UV radiation).
h. Uneven heating or one sided warming by sunshine can cause deformation of the pipe and shall be avoided. Pipes shall be protected from sunshine by covers that allow adequate air circulation.
i. Recommended maximum stacking heights for non-pallet pipe storage is 1.0m (PE pipe) and 1.5m (PVC pipe).

Stacking of pipes during storage shall be in accordance with manufacturer's recommendations.

All items for use in potable and non-potable water applications shall be maintained clean and dry (capped, plugged or blank flanged) from manufacturer's facilities to final installation, consistent with requirements of ISO 22000 for water quality assurance.

During construction, when pipes may be located outside the secured area for welding and/or laying purposes, they shall be located in a safe and stable location, secured from movement via wedges and capped to stop any vermin or the public, access internally into the pipes.

3.23. Concrete

Concrete work shall comply with the requirements of the Job Specification and Unitywater's *Pr9903 - Specification for Building and Structural Works*.

Concrete used for the construction of maintenance holes and the restoration of concrete surfaces shall be Class S32 (min.).

Concrete used for backfilling trenches under roads, Types 2 and 3 construction and in other situations directed by the Superintendent shall be Class N20 in accordance with AS 1379.

3.24. Maintenance Hole Covers and Frames

Maintenance hole covers and frames shall be of grey iron or ductile as detailed on the SEQ WS&S D&C IPAM list.

Class 'D' iron cover shall be used in roads and on premises where the maintenance hole may be subjected to heavy vehicular traffic or where directed by the Superintendent.

Concrete filled covers shall not be used due to excessive lifting weight of the lid that concrete imparts.

A bolt down cover shall be used where the maintenance hole is located in an area subject to surcharge, flooding or where directed by the Superintendent.

3.25. Water Required for Works

The Contractor shall not use a standpipe on a hydrant until such time as an application has been made to the Superintendent and a permit issued for the use of a hydrant. Any fees that the Superintendent may impose for the use of the standpipe shall be paid by the Contractor and shall be included in his Schedule of Rates or Contract Sum as applicable for carrying out the work.

The Contractor shall abide by any restrictions imposed on the use of water by the Superintendent. The Superintendent may impose a charge for water used if the Contractor is deemed to be wasting water.

Where water is required for pressure testing purposes for sewer pipeline testing, the Contractor may accept the use of recycled water in lieu of potable water sources. The Contractor shall make all necessary pumping and transportation provisions to obtain the required volumes of recycled water.

3.26. Timber

All timber used for trench shoring and the restoration of timber structures shall be suitable for the use. The timber shall be thoroughly seasoned, sound, straight and free from sapwood, large loose knots, wanes, shakes, gum veins, cores and other defects.

Timber used for restoration shall be cut, matched and framed in a tradesman like manner. The timber shall be properly arrised and shall hold to true dimensions when fixed in position.

The Superintendent may direct that timber used in trench shoring shall remain in place in the trench in order to protect adjoining improvements.

3.27. Nature of Ground

Where the Superintendent has undertaken a sub-soil testing program on the site of the works, this information shall be made available to the Contractor. It shall be the Contractor's responsibility to interpret the information supplied.

The Superintendent does not purport that the available information represents all the sub-soil conditions which may be encountered.

The Contractor shall be deemed to have satisfied himself as to the nature of the ground at the time he made the offer to carry out the works.

3.28. Disused Existing Pipelines

The Contractor shall be responsible for the decommissioning of disused or redundant pipelines in accordance with WSA 03 Water Supply Code.

Where applicable, the disused pipeline shall be flushed and scoured with recycle water with the wastewater to be discharged to an approved collection point.

The disused or redundant pipeline shall be capped or plugged with an appropriate material to be confirmed by the Superintendent. The pipeline is then to be completely grout filled unless otherwise directed in writing by the Superintendent.

All surface infrastructure (i.e. hydrants, valve boxes, air, gas release valves, etc.) shall be removed and correctly disposed.

Pipeline markers or references shall also be removed.

The location and extent of disused pipelines shall be recorded on the as-constructed information.

3.29. Handling Asbestos Cement Pipe and Fitting

Asbestos fibres, if inhaled or ingested, can lead to diseases such as asbestosis and various cancers. It is recognised that exposure to all forms of asbestos dust must be avoided to safeguard the health of those persons working with asbestos-containing products.

Where possible the Contractor shall open pipe joints and remove whole lengths of AC pipe rather than cutting.

Where asbestos material is encountered, the Contractor shall be responsible for:

- Full compliance with relevant guidelines and legislation;
- The supply and maintaining in good order of the appropriate tools and safety equipment;
- The instruction of all operators and their assistants in the proper use of such tools and/or equipment;
- The necessary supervision and monitoring to ensure that the prescribed safe working practices are adhered to;
- Necessary medical examination or treatment of employees in contact with the asbestos material. Safe Disposal of asbestos material in accordance with relevant legislation.

4. Clearing and Grubbing

4.1. General

Clearing and grubbing requirements shall conform with the requirements of the Job Specification and Unitywater's Specification for Civil and Earth Works (Pr9902).

All trees, shrubs, stumps and roots that, in the opinion of the Superintendent, are likely to obstruct or damage the works, shall be removed and disposed of and the ground surface restored. All holes made by clearing shall be filled with sound material in a manner approved by the Superintendent.

The Superintendent may require the Contractor to construct the works so that certain trees or other flora shall be preserved without damage and without interference to their limbs and roots. Trimming of trees and shrubs may be agreed to by the Superintendent and carried out by the Contractor in a proper manner to minimise permanent damage to the trees or shrubs.

Except where otherwise specified or where express instructions are issued to the Contractor, the areas to be cleared and grubbed shall be those within a horizontal distance of 600 mm of the centre of each pipeline. The Contractor shall exercise every care and where possible, shall preserve fruit trees, ornamental trees, shrubs and vegetables.

Where pipelines pass through lawns and elsewhere when directed by the Superintendent to do so, the Contractor shall carefully cut and stack turfs which shall be replaced when the work is completed. The stacked turf shall be kept moist and replaced as quickly as possible.

The Superintendent shall be responsible for claims for compensation arising from the loss of trees and other flora which the Contractor removes with the consent of or by the direction of the Superintendent within the limits defined in the previous clause. The Contractor shall be responsible for claims for loss and damage resulting from the removal of or damage to trees and other flora outside the limits set out in the previous clause.

4.2. Erosion and Sediment Control

Erosion and sediment control requirements shall conform to the requirements of the Job Specification and Pr9902 - Specification for Civil and Earthworks.

5. Pipeline Trench Excavation

5.1. General Requirements

Excavation requirements shall conform to the requirements of the Job Specification and the *relevant* SEQ WS&SD&C Code.

The Contractor shall not commence, without the consent of the Superintendent, the work of excavating trenches in any section or sections of the work and shall not at any time during the progress of the work have more than 40 meters of trench opened up ahead of pipe laying in any section of the work unless agreed by the Superintendent. In all cases, trenches shall be backfilled and made safe prior to the completion of each day's work.

Before commencing work on any pipeline the Contractor shall establish the centre of the pipeline, locate any underground services which may be present, make provision for the safe passage of foot and vehicular traffic during construction and offset any level pegs which may be located on the pipe centreline.

Trenching shall be carried out in such a manner as will cause the least interruption to traffic. Access to properties must be maintained at all times. Where traffic must cross open trenches, suitable bridging must be provided at street crossings and driveways.

The Contractor shall take such precautions as are necessary to ensure that all excavation is made in a careful manner and that it is rendered secure and safe by sheeting and/or other means. Throughout the whole of the work, the Contractor shall take all precautions against accidents, etc. whether arising from insufficient strength of sheeting, bad workmanship, breakage of machinery or plant, inadequate caulking or packing, floods or any other cause whatsoever.

5.2. Limits of Excavation

The Contractor shall keep the extent of excavation to the minimum possible to allow efficient construction of the Works while meeting the minimum requirements shown on the Drawings and the relevant Standard Drawings. The Contractor shall keep pipe trench widths within the maximum widths shown within the Contract drawings. Widening of the trench beyond the maximum specified in will increase the load carried by the pipe and will require a review of the pipe class and trench compaction method.

If the maximum width limits cannot be met, the Contractor shall seek advice from the designer and Superintendent.

The maximum length of trench open at any one time is 150 meters. An open trench is defined as any excavation that is below natural surface level. At the end of the shift the trench shall be made safe and barricaded off.

Where not otherwise shown on the drawings, the minimum width of trenches under stable ground conditions shall be as shown in:

a. AS2566.2 for flexible pipes (includes DICL and MSCL);

b. AS3725 for rigid pipe (concrete).

5.3. On-Site Stockpiles

Only sufficient materials shall be stored on site as are necessary to allow timely and efficient progress of the work. Stockpiles of excavated or imported material shall be located where they cause no interference to the public, drainage routes or vehicular or pedestrian traffic.

Clear lines of sight for drivers must not be obstructed. Materials shall not be stacked against structures, fences, trees or other property improvements. A clear path at least 600 mm wide shall be left between the edge of any excavation and the inner toe of any stockpile or spoil banks. The load due to stockpile of materials in the vicinity of any excavation shall be taken into account in the design of excavation.

All excavated materials that are to be re-used should be protected from excessive drying or wetting during storage. Additionally, these materials should be excavated, stored, handled and laid so as to avoid contamination and loss of fines.

Where stockpiling of topsoil is required, establish stockpiles in approved locations to heights not exceeding 1.5 m. The Contractor shall:

- Provide adequate drainage and erosion protection;
- Not burn off to remove plant growth that may occur during storage;
- Not allow traffic on stockpiles;
- Sow stockpile(s) of topsoil with temporary grass if a stockpile of topsoil is to remain unused for more than four weeks.

5.4. Cover Requirements

The Contractor shall ensure that the minimum cover requirements are satisfied following any earthworks which may occur in the area of the pipelines. Minimum cover for pipelines shall be in accordance with the relevant SEQ WS&SD&C Code.

The Contractor shall protect pipes from damage during construction activities where cover may be less than the minimum specified or subject to heavy or unusual loading.

The Contractor shall seek guidance from the Designer and Superintendent where the minimum cover requirements cannot be met and the proposed solution is not detailed on the Contract Drawings.

5.5. Excavation Across Improved Surfaces

The Contractor shall use tunnelling or boring techniques where possible in at least the following situations:

- Where excavation is required under improved surfaces such as pavements, driveways and kerb and gutter;
- Where the surfaces cannot be satisfactorily reproduced;
- Under existing concrete footway areas and concrete driveways.

The Contractor shall also ensure backfilling is to a standard to fully support the surface and any likely applied load.

If open excavations are used in improved surfaces, the excavation width shall be kept to the minimum allowed.

The Contractor shall provide all necessary traffic control as per QGTTM to manage excavation across roads and shall minimise the time required to complete the works. The Contractor shall provide alternative public vehicle and pedestrian access around all excavations in the roadway.

Before excavating trenches, the Contractor shall saw cut existing concrete and bituminous surfaces to provide a straight even joint during the work. All works across road carriageways are to be in accordance with the road authority conditions of approval.

Excavation along carriageways should wherever possible be located such that the edge of the opening is at least 1m from the edge of the carriageway.

The Contract shall ensure that unity paving is lifted by hand, cleaned and set aside in suitable location for later reinstatement.

5.6. Vacuum Excavation

Vacuum excavation is an efficient, safe and effective alternative to hand digging within designated tolerance zones when used appropriately. Use of equipment must follow all Government statutory laws and regulations.

Excavators must also comply with the requirements of current Environmental Legislation, Work Health and Safety Regulations and SafeWork Qld Guides and Codes of Practice.

The safe exposure of underground services within tolerance zones is essential for damage prevention. Site conditions may make the use of hand tools to expose underground facilities difficult or even impractical. Vacuum excavation is often an appropriate alternative.

Unless specifically allowed by law, approval must be obtained from the underground service owner prior to the commencement of any vacuum excavation work. Underground service owners may have specific criteria for safe excavation/exposure practices around their facilities. Some underground service owners accept vacuum excavation as equivalent to hand excavation for exposing their facilities and others have restrictions on its use. Vacuum excavation must not be used where asbestos containing material is known or suspected to be present.

Vacuum excavation is an appropriate method of excavating safely around underground services provided that:

a. The pressure and vacuum excavation equipment has been specifically designed and engineered by a excavating equipment manufacturer for non-destructive, close excavation around buried infrastructure;

b. The equipment is operated in accordance with the manufacturer's operating instructions;

c. The pressure and vacuum excavation equipment is operated in accordance with practices that provide appropriate levels of worker and public safety and prevent damage to buried facilities;

d. Use of all equipment complies with Government statutory laws and regulations and the underground service owner requirements and restrictions;

e. Documented vacuum excavation safe work practices and procedures are in place and available for review upon request by a representative of a service owner;

f. Before You Dig Australia (BYDA) shall be undertaken prior to commencement of excavations or any activities which may disturb the ground; BYDA information shall be available on site and be current and up to date;

g. Use of the equipment follows the documented safe work methods and procedures;

h. The documented safe work practices and job procedures meet service owner guidelines;

i. Only suitably experienced, competent and qualified workers operate the equipment;

j. The tools used (dig wand/vacuum tube) have been specifically designed for excavating around buried services (e.g. rubberised coating on dig wand and rubberised sleeve attached to the end of the vacuum tube).

The following procedures shall be followed when vacuum excavation technology is used:

a. A minimum distance of 200mm must be maintained from the tip of the pressure wand to the service; the nozzle shall never be inserted into the ground while excavating within the 'underground service zone'.
b. When pressurised wands are used, the maximum water pressure with a straight tip nozzle to be used at any time during excavation in public roads and easements shall be 135 bar.
c. Below a ground depth of 500mm, the water pressure to be used at any time shall be reduced to a max. 100bar.
    - When a straight tip nozzle is used, pressure measurements are to be monitored using a pressure gauge mounted on the pressure machine.
    - The max. pressure to be used at any time with a spinning nozzle during excavation shall be 200bar;
d. When a spinning nozzle is used, pressure measurements are to be monitored using a pressure gage mounted on the excavation machine;
    - The pressurized air or water wands shall never remain motionless during excavation. Aiming directly at the underground facilities shall be avoided at all times.
e. A device capable of stopping the excavation on demand, such as an Emergency Shut-off Device, shall be immediately available at the point of excavation.
f. If damage to underground facilities and/or coatings on these facilities occurs while using vacuum-excavation technology or any other method of excavation, the excavator shall contact the facility owner/operator.

5.7. Excavation in Root Zones

The Contractor shall ensure that no undue damage is caused to existing tree root systems as a result of excavation works. Tree roots larger than 25 mm in diameter shall not be cut without the approval of the Superintendent.

Where necessary, the Contractor shall ensure roots are pruned using a handsaw or secateurs, making a clean cut and making as small a wound as possible.

5.8. Support of Excavations

The sides of excavations for pipework shall be kept vertical to at least 150 mm above the pipe. Except where described in, or permitted in the Contract, the sides of excavations shall be supported at all times and shall not be battered.

When removing, raising or withdrawing supports, the Contractor shall ensure that no damage, disturbance or displacement occurs to adjacent structures along with the pipes, fittings, geotextile filter fabric, pipe embedment and trench fill already installed. The Contractor shall ensure that compaction of pipe embedment and trench fill material occurs below such trench support and against native ground.

If the trench support system is to be left in place as permanent support, the support system shall be cut off at a depth below ground surface that will satisfy the structural requirements of the site.

5.9. Adjacent Structures and Services

The Contractor is responsible for locating, identifying and contacting the owner of any service within close proximity of the trench excavation.

The Contractor shall provide a condition assessment report on any adjacent structures and services identified by the Superintendent.

The Contractor shall ensure that adjacent structures and services are not subject to disturbance by the excavation or by any trench support system.

The Contractor shall ensure that adjacent services and services which cross the excavation are adequately supported and protected during trenching. The Contractor shall liaise with the owner of the services to coordinate trenching operations and any temporary isolation of the service which may be required.

5.10. Drainage and Dewatering

The Contractor shall:

- Keep all excavations free of water;
- Provide, maintain and operate intercepting works to prevent surface water from entering the excavations and all equipment necessary for dewatering the excavations and keeping the Works free from water;
- Lower the water table by well points or other external dewatering methods only if no damage is likely to be caused to adjacent structures and services.

The Contractor shall ensure that all downstream works that are under construction, completed or in use are protected at all times against the effects of any drainage which is discharged or likely to be discharged from the Works.

The Contractor shall ensure that:

- Watercourses and other surface water drainages, including land and/or road drainage, within the Site are maintained in an effective working condition at all times;
- All practicable measures are taken to prevent the deposition of silt or other material and pollution or damage arising from construction operations and acts of vandalism, to any existing watercourse, canal, lake, reservoir, borehole, aquifer or catchment area.

The Contractor shall obtain approval for all temporary liquid discharges, crossings or diversions to watercourses from the relevant statutory authority and comply with approval requirements.

5.11. Disposal of Surplus Excavated Material and Unsuitable

The Contractor shall promptly remove and lawfully dispose of excavated material that is unsuitable for (re)use on-site at a suitable off-site location. No unsuitable material may be disposed of on-site without permission from the Superintendent.

Suitable surplus material that is not required for reuse in the Works is the property of the controlling authority or owner of the excavation site. The Contractor shall seek approval from the Superintendent on the location for disposal of such surplus material. If directed by the Superintendent the Contractor shall dispose of surplus material off site.

5.12. Trenching in Non-Rippable Rock

Non-rippable rock is defined as rock that would experience hard digging with a CAT245 excavator or similar.

Encountering rock shall be a hold point; the Contractor shall obtain agreement from the Superintendent on the extent of excavation in such circumstances.

Rock shall be excavated to reach the design trench levels as detailed on the Drawings. The Contractor shall avoid forming pockets of shattered material below the level of the excavation.

The Contractor shall remove all loose material. Any over-excavation below the design level of the trench shall be filled to formation level with embedment material approved by the Superintendent, free from perishable materials and resistant to washing. The Contractor shall compact all material in accordance with requirements for embedment material.

The Contractor shall trim the excavation to shed water.

Blasting of rock shall not be permitted.

5.13. Trench Floor Preparation and Unsuitable Foundation Material

The time for which the trench floor is exposed shall be minimised to prevent deterioration.

Prior to placing embedment, check that the proposed foundation is able to provide a firm foundation with a minimum bearing capacity of 50kPa at the required level.

Where a minimum bearing capacity of 50 kPa cannot be achieved a rock mattress, as detailed on design drawings, shall be installed at the base of the trench. The depth of the rock mattress shall be agreed with the Superintendent.

In locations where the installation of a rock mattress is not considered practical or suitable, unsuitable foundation material shall be removed and replaced. The Contractor shall obtain agreement from the Superintendent on the extent of unsuitable removal prior to starting work.

The Contractor shall excavate any localised unsuitable ground, soft spots or damaged surfaces below the formation level and then fill to formation level with approved embedment material, free from perishable materials and resistant to washing.

The Contractor shall compact all material in accordance with requirements for embedment material.

5.14. Tunnelling

The Contractor shall not undertake excavation in tunnel(s) unless shown on the Contract drawings or instructed or permitted by the Superintendent in writing to do so.

Where tunnelling is used, the maximum distance between adjacent shafts shall be determined by the Contractor and approved by the Superintendent. No pipes shall be laid until the tunnel between adjacent shafts has been holed through and finished to the required line, level and grade.

No excavation shall be deemed to be in tunnel(s) unless it is shown on the drawings or express instructions are issued by the Superintendent in writing that specific lengths of pipeline shall be so constructed.

In all underground workings, the Contractor shall take precautions prescribed in respect of mines and shall comply with all regulations applicable to such works.

The dimensions of the tunnel and the installation of the tunnel support system shall be as agreed with the Superintendent. Adequate working space to bed and lay pipes shall be provided.

5.15. Excavation under Railway Lines

The Contractor shall conform to *AS 4799 Installation of underground utility services and pipelines within railway boundaries*.

Before constructing any work under or adjacent to any railway, the Contractor shall give notice in writing to the relevant Rail Authority of the intention to commence operations.

The Contractor shall not commence any such work until written permission has been received from the Rail Authority and shall conduct the whole of the works under such conditions and supervision and with such precautions against interruption or danger to traffic as the Rail Authority directs.

The Contractor shall be solely responsible for any stoppages, delays or accidents arising out of or in any way attributable to the Contractor's operations. Should the Rail Authority consider it advisable, flagmen or other men shall be placed on any work to be executed under, over or near any railway or any railway land for the purpose of seeing that no danger occurs to the traffic or permanent way. Such action shall not relieve the Contractor of any of the responsibilities under the Contract.

The Contractor shall obtain any necessary permits and pay all fees and charges in connection with the works carried out under this clause, including the cost of the flagmen or other men referred to above.

All pipe crossings of railways shall be laid in box culverts, enveloping pipes or concrete surround as specified.

5.16. Excavation Under Controlled Roads

Work within the boundaries of State controlled roads shall be carried out in accordance with the current conditions of approval of the Road Authority.

The Contractor shall be responsible for giving the local State Road Authority Manager the required period of notice prior to the commencement of construction.

5.17. Excavation Under Other Roads

Work under road surfaces carrying vehicular traffic shall be carried out in accordance with the current conditions of approval of the Road Authority.

The Contractor shall be responsible for giving the Road Authority the required period of notice prior to the commencement of construction.

Unless otherwise specified the approved filling and backfilled material shall be compacted to prevent settlement of road surfaces.

5.18. Boring/Jacking of Enveloper Conduits

Trenchless construction by Boring/Jacking of enveloper conduits shall conform to the requirements of the Job Specification, Pr9787 - *Specification for Microtunneling and Pipejacking Construction*, Pr9789 - *Specification for Auger Boring,* Pr9790 - *Specification for Pipe Ramming,* Pr9825 - *Specification for Shafts*.

The Contractor shall carry out all work necessary for the installation of the pipeline. The Contractor shall construct temporary access, benches, standing areas, haul roads and any other facilities necessary for the installation and completion of the pipelines and associated works. Upon completion of the pipeline the Contractor shall reinstate those areas affected by such work to their original geometry, function and condition.

The pipeline shall be constructed by progressively boring/jacking an approved enveloping pipe. The enveloper pipe installed shall be in accordance with the specifications of the relevant authority. All such boring/jacking shall be done without disturbance to existing road, structures, works or services. The Contractor shall be responsible for thoroughly assessing ground conditions, determining boring and thrusting conditions and all design work required.

The pipeline shall be installed in the enveloping conduit. The Contractor shall use a method of installation that does not damage the pipeline.

The void between the pipeline and the enveloping pipe shall be pressure grouted using an approved flowable Portland cement grout. The Contractor shall ensure that the manufacturer's recommended allowable external pressure for the pipe is not exceeded and that the pipeline does not suffer any deflection, distortion or damage as a result of the pressure grouting.

The pipeline shall also be managed to flotation and thermal reversion during the grouting procedure.

All boring, jacking and pressure grouting work shall be performed by specialist personnel who are suitably qualified and experienced with the equipment and construction method.

5.19. Horizontal Directional Drilling

Trenchless construction by Horizontal Directional Drilling shall conform to the requirements of the Job Specification and Pr9788 - *Specification for Horizontal Directional Drilling (HDD) Construction.*

The Contractor shall carry out all work necessary for the installation of the pipeline. The Contractor shall construct temporary access, benches, standing areas, haul roads and any other facilities necessary for the installation and completion of the pipelines and associated works. Upon completion of the pipeline, the Contractor shall reinstate those areas affected by such work to their original geometry, function and condition.

The method of construction shall include but not limited to the following:

- Pilot hole drilled along the design alignment using a steerable and trackable drill;
- The pilot hole is reamed to the required diameter in one or more passes;
- The carrier pipeline is pulled through the enlarged borehole;
- The drilled hole is continuously stabilised by use of a drilling fluid.

All such drilling work shall be done without disturbance to existing road, structures, works or services. The Contractor shall be responsible for thoroughly assessing ground conditions, determining drilling and pressure conditions and all design work required.

The Contractor shall use a method of installation that minimises installation depth and does not damage the pipeline.

The Contractor shall ensure that the manufacturer's recommended allowable loads on the pipe is not exceeded and that the pipeline does not suffer any deflection, distortion or damage as a result of the drilling work.

All horizontal directional drilling work shall be performed by specialist personnel who are experienced with the equipment and construction method.

6. Laying and Jointing Pipes

6.1. General

All pipe laying shall be supervised by persons having at least 2 years' experience in laying the relevant pipe material. Alternatively, pipe layers with 2 years' experience in other pipe materials and who have successfully completed the Pipe Laying Program for the relevant pipe material within the previous 3 months may supervise the laying of pipe.

An accredited pipe layer shall be on site while pipes are being laid and bedded. Records of experience (including references) and/or training qualifications for all site team members shall be provided to the Superintendent prior to the commencement of Work.

Flexible pipelines (including DICL and MSCL) shall be installed in accordance with the requirements of AS 2566 Part 2 unless otherwise noted in this Specification.

All pipelines shall be laid to such lines, gradients and levels as are shown on the drawings or as may be otherwise directed by the Superintendent.

It is the Contractor's responsibility to preserve uniform gradients and correct alignment.

Abrupt changes of grade such as might result from minor irregularities of surface or otherwise must be avoided. The maximum tolerance in horizontal alignment shall be ± 75 mm. The Superintendent will carry out compliance checks at times nominated by the Superintendent.

If any audit check finds the pipe incorrect in size, level or grade the Contractor shall, at his own cost, recheck the pipes laid between the previous correct audit and the incorrect audit pipe and remove and relay all pipes found incorrect.

Any pipes damaged during the course of such removal shall also be replaced at the Contractor's cost.

Where shown on the Drawings, special bends shall be provided for effecting horizontal or vertical changes of direction. Where such bends are not shown on the Drawings, changes of direction shall be effected by angling the joints.

No joint shall be angled to such an extent as to impair its effectiveness and tightness.

When making a joint, pipes should always be in line and if required, deflection made after making the joint. The deflection shall not be greater than the maximum value recommended by the pipe manufacturer.

Pipes shall be cut (by the methods specified herein) where and in such lengths as necessary to conform to the horizontal and vertical alignment shown on the Drawings.

Before laying, all pipes and fittings must be thoroughly cleaned of all dirt on the inside and the greatest care must be exercised to prevent dirt or foreign matter entering the pipes during the operation of laying and jointing. Particular attention shall be paid to cleaning the jointing faces.

All open ends must be protected against the ingress of dirt or foreign matter by the use of plugs in a manner satisfactory to the Superintendent.

Unless otherwise specifically approved in writing by the Superintendent, pipelines shall be laid, jointed and checked in complete lengths from maintenance hole to maintenance hole or structure to structure prior to commencement of backfilling.

The Superintendent will, in exceptional circumstances such as crossing of important roads, works adjacent to buildings and extreme weather conditions, give consideration to any request from the Contractor for approval to commence backfilling at an earlier stage, but will not approve any such request unless such action is, in the Superintendent's opinion, necessary in the circumstances. The Contractor shall adopt measures to control the line and level of the pipeline.

The Contractor shall ensure that pipes to be embedded in the walls of structures are laid and retained in correct position and level. Where such pipes are at or near floor level of the structure, they shall be fixed by bedding the pipes on the concrete maintenance hole bottom placed in conjunction with laying and jointing of pipes or by other approved methods.

Seals for future inspection and maintenance purposes and temporary seals shall be made with an approved factory-made sealing plug and flexible watertight joint.

The plug shall be restrained from movement by an approved metal clip suitably protected against corrosion by hot dip galvanising and wrapping.

A square of polythene sheeting approximately 375 mm x 375 mm shall be used to cover the plug so as to prevent entry of sand, soil etc. into the joint.

All seals shall be watertight under the specified test heads applied either internally or externally. Other approved seals may be used.

Joints in pipelines shall be of the flexible types using rubber jointing rings supplied with the pipes for that purpose. Lubricants shall be used where specified by the manufacturer.

Spigot and socket joints shall be marked with gauge lines so that the pipe layer can judge the penetration achieved at the joint. The joints shall be cleaned before mating.

To avoid damaging the end of the pipe during jointing, a suitable timber spacer shall be used between the pipe and the lever. Extreme care shall be exercised to avoid damage to any external coating of the pipe when the joint is pulled together.

For jointing of PE pipes refer to Section 6.8 Jointing PE Pipes and Fittings.

6.2. Electrical Safety when Working on Metallic Pipelines/Metallic Water Services

There may be a risk to Unitywater team members, Contractors as well as Customers/Premise Occupants, of working in the vicinity of, or making contact with electricity, when work is carried out on above or belowground metallic pipelines and/or metallic water services.

All work conducted on metallic pipelines including metallic water services must be in accordance with AS 4853 Electrical Hazards on Metallic Pipelines and shall meet all statutory authority requirements.

The contractor shall have developed and implemented a Safe Work Method Statement (SWMS) to address all electrical safety. The contractor shall always consider that metallic water pipework may contain electricity when doing the risk assessment for any work.

The contractor must have developed and implement a program to regularly monitor the work to ensure it is conducted in accordance with the SWMS.

6.3. Lift and Re-lay Construction

Lift and Re-lay method of construction encompasses the construction of individual sections of potable and recycle water mains ≤ 50 metres in length, utilising the 5C's water hygiene program.

This method of construction, where approved by Unitywater shall be in accordance with the method described below.

Step 1 - Construction:

a. Isolate the section of Lift and Re-lay main by installing a restrained Temporary Gate Valve and Fire Hydrant at each end of the project's section.
    i. Fire Hydrant to be located directly adjacent to and on the Lift and Re-lay side of the valve;
    ii. Pressure test each Temporary Gate Valve for zero leakage from both sides of the valve (pressure test results to be provided to Unitywater);
    iii. These tested valves to be used for pressure testing the completed works.
b. Construct sections of main (≤ 50 metres in length) in accordance with the 5C's water hygiene program;
c. Reconnect water services at the end of each day's work to the new section (leaving ferrules accessible);
d. Flush main through the end Fire hydrant at the end of each day in accordance with WSA 03 Appendix 'I' Section I4.3 Cleaning Methods;
e. Flush reconnected water services and return to operation;
f. Repeat process daily until all the Lift and Re-lay sections have been completed.

Step 2 – Pressure Testing:

g. Isolate the completed Lift and Re-lay section utilising the installed Temporary Gate Valves;
h. Confirm Gate Valves have been pressure tested and results provided to Unitywater;
i. Isolate each service connection at the ferrule on the main and at the water meter to provide dual isolation and protection of the customers internal plumbing;
j. Pressure testing existing water services is not required for Lift and Re-lay method;
k. Conduct standard pressure test of the Lift and Re-lay section in accordance with SEQ WS&S D&C Code.

Step 3 – Commissioning:

l. At pressure test pass, open an end valve in Lift and Re-lay section and ferrules/valves on water services and conduct complete flushing of main and water services in accordance with WSA 03 Appendix 'I' Section I4.3 Cleaning Methods;
m. At completion of flushing, open remaining closed valve;
n. The Lift and Re-lay main is now commissioned;

If required by Unitywater, Temporary Valve and Fire Hydrant can be removed at completion of works and replaced with a gibault drop-in pipe section in accordance with the 5C's water hygiene program.

6.4. Handling FBP Coated Pipes

When handling FBP coated steel pipes, the greatest care shall be exercised to avoid damage to the pipe or coating. Under no circumstances shall a pipe be lifted by unprotected slings or levered or moved by implements without protecting pads.

Lifting slings shall not be less than 300 mm wide. Where pipes are lowered onto the ground they shall rest on padded bolsters or on padded ramps or on padded cradles. Heaps of sand or soft earth as supports will be acceptable. Pipes with uncoated ends may be lowered onto the ground with chocks placed only under the ends left uncoated. Any damage to the pipe coating occurring after delivery shall be made good by the contractor at his own expense.

6.5. Testing of FBP Coating

Before the FBP coated steel pipe is placed onto its bedding the pipe shall be tested for defects in the external coating by means of a high voltage holiday testing apparatus capable of testing at 15,000 volts. Testing shall be in accordance with AS3894.1. Safety procedures must be strictly followed. The earth should be on the current mortar lining. At any place where the apparatus gives a spark or discharge through the coating to the steel pipe it will be taken that a defect in the coating exists and all such defects shall be repaired at the contractor's own expense and retested to the satisfaction of the Superintendent.

Repairs to the FBP coating shall be in accordance with AS4321. The contractor shall provide a skilled workman to do this work and in the first instance he shall arrange for the manufacturer to have one of their repairers to be on the job to supervise and train the contractor's repairer in this work. All expenses in this regard will be at the contractor's cost.

6.6. Jointing Steel Pipes and Fittings

Steel pipes and fittings shall comply with AS1579.

Flanges shall be raised joint face type.

Bolt holes shall be truly off centre lines. In double flanged pipes the holes in one flange shall be in line with and opposite to the holes in the other unless specified otherwise.

Flanges shall comply with AS4087. Bolts, nuts and washers shall be stainless steel complying with Clause 3.2 of AS4087.

6.7. Jointing ABS Pipes and Fittings

Solvent cement joints shall only be performed by trained operators certified by the pipe supplier. Certificates of qualification shall be provided to the Superintendent prior to work commencing.

Prior to work commencing the Contractor shall perform a test join to demonstrate the joining method and equipment to be used in the Contract works. This shall include a pressure test of the completed joint. This test will be witnessed by the Superintendent.

Moulded fittings shall be used in the works unless otherwise advised in the Job Specification.

For flanged jointed pipes grade 316 stainless steel backing rings shall be used. Threaded joints shall only be used if permitted by the Job Specification.

6.8. Jointing PE Pipes and Fittings

6.8.1 Product Specification Requirements

PE pipes and fittings shall be jointed in accordance with AS 2033, SEQ WS&S D&C Code, WSA01 Polyethylene Pipeline Code and PIPA Technical Guidelines.

PE Pipe shall conform to AS/NZS 4130 Series 1 and shall be coloured both internally and externally in accordance with the SEQ WS&S D&C IPAM List. Repairs to PE pipes are not permitted. Pipe sections exhibiting damage greater than 10% of the wall thickness shall be removed. Ensure PE pipe is quality checked for ovality flat spots, and dimensional tolerance.

Fittings for PE pipes shall conform to AS/NZS 4129 and shall comply with the SEQ WS&S D&C IPAM List.

Fabricated fittings shall only be used where permitted in the Project Specification.

6.8.2 Preferred jointing types for PE pipe and fittings:

Butt fusion jointing is Unitywater's preferred method for joining PE pipes.

Electrofusion jointing may be used for property sewer connections and reticulation sewers pipe in sizes up to and including 160ND.

Electrofusion jointing in sewers larger than DN160 shall be engineered out where possible to limit their use. The use of electrofusion joints in sewers larger than DN160 requires the prior approval of Unitywater. The use of electro-fusion or mechanical joints on PE trunk water mains (including at connection points) requires the prior written approval of Unitywater.

Electrofusion jointing is not acceptable jointing method for sections of PE pipe that will be pulled into place or use trenchless construction methodologies.

Threaded joints shall only be used if permitted by the Project Specification.

Gripper type joints for connection of non-pressure PE pipe are not approved by Unitywater.

Flange joints for connecting non-pressure PE pipe lengths are not approved by Unitywater.

The Contractor shall submit full details of the proposed jointing methodology to Unitywater for approval, prior to undertaking the work.

6.8.3. Jointing Methodology

The design drawings shall contain a detailed jointing methodology. This methodology maybe amended, with agreement from Unitywater, prior to construction starting. The jointing methodology shall be in the Construction Quality Plan.

6.8.4 Welder Competency

Butt Fusion and Electrofusion joints shall only be performed by suitably trained and experienced operators with current welding certification. Certificates of qualification, evidence of previous work history and references, shall be provided to Unitywater.

- For Butt weld jointing, all welding operators shall be qualified to PMBWELD301E – Butt weld Polyethylene Plastic Pipelines.
- For Electrofusion jointing, all welding operators shall be qualified to PMBWELD302E– Electrofusion weld Polyethylene pipelines.

Operators shall be experienced with the equipment and pipe sizes relevant to the work being undertaken and must produce evidence of such experience to the satisfaction of Unitywater.

All welders shall undertake preconstruction field weld qualification. Diameter ranges are:

- 250mmOD and under;
- 355mmOD to 560mmOD;
- Above 560mmOD.

6.8.5 Weld Testing Requirements

For butt welding a Weld Procedure Specification (WPS) shall be submitted for each model fusion machine. WPS shall be relevant to the machine's capabilities. The WPS shall cover every pipe size and SDR relevant to the project The WPS shall include a summary of the weld parameters, including cooling times and time before rough handling.

A Weld Procedure Qualification (WPQ) shall be submitted for each individual model butt fusion and electrofusion machine. A test coupon shall be completed for each individual pipe size and SDR on the WPS. WPQ shall consist of:

- A copy of the Weld Procedure Specification (WPS);
- A check sheet for each test coupon demonstrating compliant visual inspection.

Welder Pre-Qualification (WQ) shall be submitted for each individual to be eligible to perform any PE jointing on an associated fusion machine. If multiple machine models or manufacturers are to be used on the project, the welder shall be qualified to the corresponding WPS associated with each machine. WQ shall consist of:

- Cover page for welder details including:
  i. RTO course qualification details and date of completion
  ii. Unique welder I.D;
  iii. Weld Procedure Specifications qualified to with relevant pipe size and SDR;
- Daily weld sheet traceable to the test coupon;
- Visual inspection check sheets.

Electrofusion Joint Preconstruction Qualification

Pre-construction, each welder shall complete a minimum of two joints for the applicable pipe size range using the nominated associated fusion machine. If multiple sized pipe is to be used on the project, a minimum of one joint per size using the nominated fusion machine. The test coupon shall have

- A Visual inspection of the completed weld undertaken and assessed against PIPA POP014 Table 4. The results shall be recorded on a check sheet.
- A peel decohesion test performed by a NATA accredited laboratory in accordance with ISO 13954 (1997). Test welds shall display >66.7% ductile mode of separation.

Butt Fusion Joint Preconstruction Qualification

Pre-construction, each welder shall complete two joints for each applicable pipe size range using the nominated fusion welding machine. The test coupon shall have

- A Visual inspection of the completed weld undertaken and assessed against PIPA POP014 Table 4. The results shall be recorded on a check sheet.
- A peel decohesion test performed by a NATA accredited laboratory in accordance with ISO 13954 (1997). Test welds shall display >66.7% ductile mode of separation.

Visual inspection check sheets and destructive test results for test coupons may be used to approve both the WPQ and WQ simultaneously. No PE pipe production joints shall be carried out until the WPQ and WQ are formally accepted by Unitywater.

6.8.6 Welding Quality Records

The Contractor shall maintain an Inspection and Test Plan (ITP) which includes records of site welding. Quality records for all welds shall be provided to Unitywater. The following minimum information shall be included:

- Weld number;
- Date and time;
- Location;
- Welder identification;
- Welding equipment used;
- Pipe size and SDR;
- Date and time pipe manufactured (including pipe number if available);
- Confirmation that the weld meets the visual inspection requirements; and
- All destructive test results.

6.8.7 Butt Fusion Welding

Butt fusion welding minimum requirements in addition to WSA 01:

- No butt fusion welding shall be undertaken within the pipe trench. This condition can only be relaxed under special approval by Unitywater;
- Only pipe supplier approved, well maintained automatic welding machines of suitable size including clamp frame, clamp shells shall be used;
- The machine shall have either automatic logging facilities incorporated or be retrofitted with suitable logging facilities.
- All equipment, particularly the electrically heated plate, shall be well maintained and always kept in a clean condition. The equipment shall be serviced and calibrated as recommended by the manufacturer. The pressure gauge shall be graduated to be reliably readable to 10 kPa or less and calibrated at least within the last 12 months. The heater plate shall be undamaged, and temperature controlled.
- Other ancillary equipment required for butt fusion jointing shall be available on site, including the clamping device with one fixed and one movable clamp, supported on a rigid frame, pipe support rollers or skids, pipe end plugs or caps, and the weld bead measuring gauge.
- Installers must erect tents or shelters to protect assemblies to be welded when rain or showers, high UV or windblown dust may occur during the welding process;
- Welding parameters for the machine and pipe are to be confirmed and correct. The welding parameters in the latest version of PIPA POP 003 should be form the basis of the welding parameters.
- The heater plate temperature to be confirmed with a thermometer prior to jointing;
- Generators must be adequately sized for the weld, and regularly serviced or maintained. The length of power cable between the generator and welding machine should be minimized.
- The pipe is to be located on support rollers;
- Pipe clamps are the correct size and clean to ensure correct alignment;
- Only manufacturer approved alcohol wipes are to be used; do not under any circumstances use methylated spirits, acetone, methyl ethyl ketone (MEK) or other solvents to clean the fusion area. Rags of any kind with or without any alcohol solvent are not to be used to clean the fusion area given the possibility of introducing dye, dirt, detergent, fabric conditioner or other contaminants into the fusion zone.
- Butt fusion jointing shall only be used to join pipes and fittings that are composed of similar materials (e.g. PE 100 shall be welded to PE 100), the same nominal diameter and the same wall thickness measured by Pressure Number (PN) or Standard Dimension Ratio (SDR). Pipes of different SDR (wall thickness) must not be butt welded. PN20 PE pipe used for HDD maybe trimmed to connect to PN16 PE pipe.;
- Reversion or ‘toe-in’ at the pipe ends must be cut off to ensure pipe dimensional compliance with the requirements of AS/NZS 4130.
- The welded joint shall be kept immobile for the full cooling times, before removing clamps or moving the joint assembly. The joint must be cooled in accordance with the WPS before removal from the machine;
- A bead gauge is to be used to check that the joint bead width meets the guidelines from PIPA POP 003. Neither internal nor external beads shall be removed unless specified.

6.8.8 Electrofusion Welding

Electrofusion welding minimum requirements (including EF Branch saddles) in addition to WSA 01;

- Welding machines (also known as Control Boxes) must conform to ISO 12176-2 – Plastic pipes and fittings – Equipment for fusion jointing polyethylene systems – Part 2: Electrofusion. Welding machines are calibrated on time frequency (e.g., every 12 months) or number of welds performed (e.g.200 welds). Operators must follow the manufacturer's guidance.
- Generators must be adequately sized for the fitting being welded, and regularly serviced or maintained. The length of power cable between the generator and welding machine should be minimized.
- Other ancillary equipment required for electrofusion jointing shall be available on site, including pipe cutting tools, peeling tools, ovality gauges, pi tape, vernier callipers or micrometres, permanent marker, re-rounding and alignment clamps.
- Installers must erect tents or shelters to protect assemblies to be welded when rain or showers, high UV or windblown dust may occur during the welding process.
- Ensure PE pipe is quality checked for ovality, flat spots, and dimensional tolerance. Pipe should be re-rounded if necessary.
- Reversion or 'toe-in' at the pipe ends must be cut off to ensure pipe dimensional compliance with the requirements of AS/NZS 4130.
- Ensure the fitting barcode or label are checked and that welding parameters for the machine and pipe fitting are confirmed and correct.
- Suitably sized pipe clamps capable of aligning and restraining the pipe and fitting assembly shall be used.
- Mechanical peeling tools capable of removing a minimum of 0.2mm of the oxidised polyethylene from the pipe surface, are to be used. Hand scrapers are not permitted. Blunt peeling tool blades should be replaced.
- Peeled pipe strip thickness shall be measured with Vernier or micrometre gauge, to ensure minimum peel depth removal. The peel strip thickness should be greater than:
    - 0.3mm for pipe less than DN315; or
    - 0.4mm for pipe greater than DN315; or
    - two rotary mechanical peels have been conducted without exceeding the minimum peeled pipe OD.

  To prevent excess peel reduction of the pipe OD, observe the min pipe OD after peeling specification, measured using Pi tape, respective to the pipe dimension.
- Only manufacturer approved alcohol wipes are to be used; do not under any circumstances use methylated spirits, acetone, methyl ethyl ketone (MEK) or other solvents to clean the fusion area. Rags of any kind with or without any alcohol solvent are not to be used to clean the fusion area given the possibility of introducing dye, dirt, detergent, fabric conditioner or other contaminants into the fusion zone.
- The weld should be performed as soon as possible after the assembly has been prepared to prevent reversion and/or moisture and dust contaminating the prepared weld.
- Fittings shall remain in sealed bags, or original packaging, until the point and time of installation.
- Post weld checks should include ensuring the fusion indicator pins have risen, no melted material exuded from the fitting, the control box has completed its cycle without error messages, and the assembly shows no sign of having moved.

- Allow the weld to cool for the time stated on the fitting before removing pipe clamps.
- Re-fused (second weld) EF welds will not be accepted.
- For electrofusion welding of pipes and fittings ≥DN315, the contractor shall provide third party certification that EF welding has been completed in accordance with Unitywater specifications, manufacturers requirements and industry guidelines.
- All Electrofusion Branch Saddles shall be tapped after completing the weld cycle.
- QA records of each completed electrofusion weld in accordance with PIPA POP001 "Appendix 'A' Sample Weld Record Sheet" in addition to the "Equipment Servicing and Calibration Sheet" must be available to Unitywater if requested.

6.8.9 Joint testing during construction

Once a welder has successfully completed the preconstruction weld qualification, every welder shall have one ~~a~~ minimum of one (butt fusion or electrofusion) weld in twenty (20) selected at random by Unitywater for testing.

Property Service Connections

Property service connections (and fire services) do not require weld test results when comprising of not more than five (5) joints in length from the main to the legal boundary. The laterals shall undergo a visual inspection of all joints (whilst under the adjacent than network reticulation pressure). Photographic records of all stages of the weld preparation and completion shall be provided with the as built records.

Reticulation Pipework

For (butt fusion or electrofusion) welds in reticulation pipes (excluding property connections) smaller than 160ND, a minimum of one weld in every 240m length of pipe (as measured along the length of the pipe), selected at random by Unitywater.

6.8.10 Weld Test Acceptance Criteria

Weld Test Acceptance Criteria for Butt Fusion Welds

The acceptance criteria for butt fusion joints being destructively tested shall be as follows:

- Visual inspection of the completed weld shall be undertaken and assessed against PIPA POP014 Table 1 and Table 2. The results shall be recorded on a check sheet.
- Destructive tensile testing shall be performed by a NATA accredited laboratory in accordance with ISO 13953 (2001). Test welds shall exhibit ductile failure, have no evidence of contamination in the weld plane and minimum tensile strength of 90% parent pipe.

Weld Test Acceptance Criteria for Electrofusion Welds

The acceptance criteria for electrofusion joints being destructively tested shall be as follows:

- Visual inspection of the completed weld shall be undertaken and assessed against PIPA POP014 Table 4. The results shall be recorded on a check sheet.
- The peel decohesion test shall be performed by a NATA accredited laboratory in accordance with ISO 13954 (1997). Test welds shall display >66.7% ductile mode of separation.

6.8.11 Other Testing

Relaxation of ongoing testing requirements may be applied for by the Contractor for non-critical sections such as exposed pipework and short trenched sections.

The Contractor may apply for a relaxation for the destructive testing requirements and use non-destructive testing (NDT) or automated weld machine monitoring instead. Unitywater will consider each application at its discretion.

Unitywater, at its discretion, may require NDT of critical joints on a trunk pipeline. These may include connections to existing pipelines, and section valves. These additional requirements will be notified to the Contractor on the "issued for construction" drawings.

6.8.12 Non-Compliant Weld Test Results.

A non-compliant test result for either a butt fusion or electrofusion weld shall be investigated to determine the root cause of the failure and trigger the following process.

- Both the welder who performed the joint and the fusion welding machine shall be removed from production and investigation carried out to determine the root cause. The Contractor and Unitywater shall review the WPS and welding log to determine the cause of the unsatisfactory joint and possible corrective actions.
- Should the non-compliant weld be deemed to not be an issue with the fusion machine, the previous two joints shall be cut out and destructively tested as per Section 6.8.10 Weld Test Acceptance Criteria.
    i. If either destructive test results exhibit a non-compliant result, the pipeline shall be quarantined between the last acceptable test result and current failure location. The welder shall have to satisfactorily reperform the Pre-Construction Qualification tests.
    ii. Proceeding activities shall be decided upon by Unitywater with the possibility of cut outs until acceptable destructive test results are obtained or complete replacement of the pipe.
- If the failure has been determined to be due to an issue with the WPS, the methodology shall be amended to incorporate any corrective actions.
- Fusion machines with 2 or more brittle failures shall be either replaced or returned for maintenance. Prior to a fusion machine being allowed back into production welding it is required to produce a compliant test coupon to the destructive test acceptance criteria.

6.8.13 Gripper type restrained joint connections:

- Installed Gripper type connections to be in accordance with manufacturers requirements;
- They shall only be performed by suitable trained and experienced operators with current manufacturers certification;
- Install PE pipe Insert Stiffener where required by fitting manufacturer (for watermains only);
- Toe-in at pipe ends is to be removed by trimming pipe back to ensure pipe dimension comply with the requirements of AS/NZS 4130;
- Quality records of each completed gripper type joint shall be provided to Unitywater.

6.9. Jointing Concrete Pressure Pipes

Concrete pressure pipes shall comply with AS 4058.

The information required by Appendix B of AS 4058 will be provided in the Project Specification or will default as follows:

- The intended application;
- Pressure application;
- Where pipes are to be jacked, the end squareness tolerance;
- Same tolerance as stated in Clause 3.3.8 of AS 4058.

All ductile iron fittings used with concrete pipe shall be sleeved with polyethylene sleeving using the procedures given in AS 3681.

Unless otherwise noted in the Job Specification all concrete pipes shall be rubber ring jointed and installed in accordance with AS 3725 and the pipe manufacturer's installation instructions.

Cutting of concrete pipe is not permitted.

6.10. Fittings, Valves, Air Valves, Scour Valves, etc. – General

A PVC, PE, PP, GRP and ABS pipe socket shall not be joined to a cast or ductile iron spigot.

Where DI or grey socketed fittings are used in PVC, PE, PP, GRP and ABS pipelines, the sockets shall be of a design which provides an effective sealing length appropriate to the coefficient of thermal expansion of the relevant material.

A minimum length of 600 mm of plain pipe shall be laid between socketed fittings.

Valves, bends, tees, tapers and scour tees shall be located in fixed positions. The pipes shall be cut to achieve the set locations.

Air valve tees shall be jointed into the line between full pipe lengths and the pipeline graded so that the air valve is at the highest point.

The backfilling around the bodies of buried sluice valves shall be sand or gravel thoroughly compacted. Such sand or gravel shall fill the full width of the trench and shall extend along the trench for a length of at least four times the valve diameter on both sides of the valve.

Where butterfly valves are bolted into the pipeline, the Contractor shall check that there is adequate clearance between the valve disc and the adjacent pipes when the valve is opened and closed.

The Contractor shall also ensure that the sealing surfaces of the valves shall bed on the metal face of the pipework flanges, not on the cement lining.

If the valve sealing surface does not bed on the metal face, the Contractor shall install stainless steel insertion rings and additional rubber insertion joint rings.

Where the cap of a sluice valve is below the reach of a standard valve key when operated from ground level or normal operating level in a valve pit, the Contractor shall supply and install an extension spindle.

Extension spindles shall be a hot dip galvanised steel shaft of solid rod or hollow section tube, and of sufficient diameter and wall thickness to resist torsion under actuation, and flex between supports. The extension shaft shall be positively fixed and retained on the spindle cap.

6.11. Couplings

Couplings shall be suitable for in-ground installation on pipelines laid in soils which may be subject to ground movement.

Couplings shall be one of the three listed types as detailed on the drawings:

- Unrestrained mechanical couplings;
- Stainless steel band type couplings consisting of a rubber sleeve retained by a stainless steel band with the band tightened by several bolts tangential to the pipe circumference (Band type coupling; Teekay, Shraub or similar);
- Dismantling joints (thrust and non-thrust type);
- Loose flanges with thrust restraint (Adapta Flange or Uni-flange) shall only be permitted for use on aboveground pipework or within pits.

6.12. Unrestrained Mechanical Couplings

Unrestrained mechanical couplings shall comply with the Industry Standard for Unrestrained Mechanical Couplings WSA 105.

The couplings shall be coated in accordance with clause 2.4 of WSA 105. Non-ferrous components shall be coated with a synthetic resin based coating.

Rubber rings shall comply with AS 1646.

6.13. Stainless Steel Band Type Couplings

Couplings shall be manufactured from Grade 316 stainless steel, with Grade 316 stainless steel fasteners and EPDM sealing sleeves complying with AS 1646.

6.14. Dismantling Joints

Dismantling joints shall be either thrust type or non-thrust type depending on the pipeline arrangement;

Dismantling joints shall be manufactured from ductile iron with natural rubber seals complying with AS 1646. Bolts, nuts and washers shall be stainless steel complying with this Specification.

Loose flanges or Uni-flanges (with thrust restraint – adapter flange or unflanged) shall be manufactured from ductile iron. This type of joint shall only be used aboveground or within pits as shown on the drawings or permitted by the Project Specification.

Loose flanges shall be supplied complete with stainless steel set screws of sufficient number and size to restrain the full thrust associated with the working pressure nominated by the manufacturer. The flange shall be supplied with a table indicating the required torque in Nm to be used in tightening the set screws.

Unless otherwise stated, loose flanges shall be suitable for the following working pressures (Allowable Operating Pressure as defined in AS 2280):

a. Restrained
   i. Up to 300 mm dia. 1600 kPa
   ii. 350 mm to 600 mm dia. 1000 kPa
b. Non-restrained
   i. 50mm to 600mm 1600kPa

6.15. Under Pressure Cut-in Connections

Under pressure cut-in connections (UPCIC) to pressure mains of sizes DN80 – DN450 shall be conducted in accordance with WSA 03 UPCIC Supplement.

The supplements stated limitations shall be addressed when assessing the viability of construction of a UPCIC.

For work safe requirements associated with potential hazards associated with existing Coal Tar coated pipes refer Section 3.14 Existing Coated Pipes (Hazardous substances)

6.16. Wrapping of Flanges and Couplings

All materials and procedures shall be by a recognised manufacturer of corrosion protection systems and shall be acceptable to the pipe manufacturer.

The Contractor shall use only fully trained and experienced personnel for the wrapping of flanges and flexible couplings.

Where DI pipes are specified to be wrapped, sufficient polyethylene sleeving and sealing tape in accordance with AS 3680 shall be supplied to sleeve all pipe supplied for the job.

Flanges

The wrapping procedure for flanges shall be:

- Wire brush loose dirt and loose rust from the flange and adjacent pipe and 100 mm onto the coating;
- Apply primer to all metal surfaces;
- Mould butyl mastic between individual bolts and nuts and over the heads of bolts, nuts and screw threads, with a minimum coverage of 5 mm and tapering onto flange face to provide a suitable contour for tape wrapping;

- Apply section of flexible tape longitudinally over the flange, extending a minimum of 50 mm onto the pipe barrel; assure that each additional section overlaps the previous by 55% to ensure a double thickness of tape;
- Finish each side with a circumferential wrap around the pipe to lock in the ends of the tape sections applied longitudinally and continue until 100 mm onto the factory applied coating.
- Thoroughly inspect the finished wrapping to ensure that all overlaps are sealed to prevent moisture and foreign material from working in under the tape.

Couplings

Wrapping shall not be used on stainless steel couplings.

Wrapping procedure shall be:

- Wire brush loose dirt and loose rust from the joint and adjacent pipe;
- Apply primer to all metal surfaces;
- Fill between bolts and sleeve, and around bolts to top of the retaining rings with butyl mastic;
- Cover bolt heads, nuts and any protruding thread with butyl mastic;
- Commencing 100 mm clear of the butyl mastic and a minimum of 50 mm onto the factory applied coating, apply flexible tape spirally with a 55% overlap and complete 100 mm past the butyl mastic on the other side or a minimum of 50 mm onto the factory applied coating.

6.17. Tapping Bands

Tapping bands shall consist of two semi-circular rings manufactured from gunmetal. The two rings shall be bolted at the horizontal diameter using gunmetal studs and nuts.

The upper ring shall incorporate an elastomeric seal designed to prevent leakage between the pipe and band at any pressure between atmospheric and 90 m head.

The two rings shall be designed so as to provide full circle pipe support and to prevent over-tightening.

Tapping bands shall not be used on PE pipelines.

6.18. Valve Boxes and Hydrant Boxes

Valve boxes shall comply with SEQ WS&S D&C drawings SEQ-WAT-1303 and SEQ-WAT-1304.

Hydrant boxes shall comply with WSA drawings SEQ-WAT-1305 and SEQ-WAT-1306.

Coatings shall comply with Clause 6.2.1 of AS/NZS 2544.

The Contractor shall fix cast iron cover boxes over all buried sluice valves and hydrants. At all sluice valves and hydrants, gravel and sand shall be filled into the trench and compacted to form a support for bricks upon which these cover boxes are to be fixed.

The bricks must be of good quality, well burnt and of uniform standard size; samples are to be submitted and no bricks may be used that have not been approved by the Superintendent.

For non-trafficable locations, high impact plastic base with PVC shroud and recycle plastic surround with full colour pigment shall be used.

Box surrounds are to be carefully laid on selected filling and maintained so that their tops are 6 mm higher than the tops of the cast iron cover boxes.

6.19. Painted Coatings

Painted coatings to be in accordance with Unitywater specification Pr9693 - *Specification for Mechanical Installations.*

Selection and application of coatings shall be in accordance with WSA 201 Manual for selection and application of Protective Coatings

6.20. Flange Gaskets

Flange gaskets shall comply with AS 4087, Clauses 3.3 and 3.4 except that gaskets shall cover the full face of the flange and shall be cleanly cut to size and all holes shall be accurately punched to the required size, location and pitch.

6.21. Bolts, Nuts and Washers

Bolts shall be Grade 316 stainless steel hexagon head bolts complying with Appendix C of AS 4087.

Nuts shall be Grade 316 stainless steel hexagon nuts complying with Appendix C of AS 4087.

Each bolt and nut set shall be supplied with one washer. Washers shall be manufactured from Grade 316 stainless steel.

Bolt length shall be equal to the sum of the thickness of the flanges, gaskets, nut and washer and rounded up to the nearest standard size.

Bolts shall exhibit a clean cut thread with no burrs or torn peaks on the thread. Nuts must turn freely on the threads without binding.

Nickel – based anti-galling compound shall be supplied in sufficient quantity to allow liberal application of the compound to the mating surface.

Anti-galling compound shall be used for both coated and non-coated bolt assemblies.

7. Welded Joints in MSCL Pipelines

7.1. Working Safely with MSCL Coal Tar Coated Pipelines

For work safe requirements associated with potential hazards associated with existing Coal Tar coated pipes refer Section 3.14 Existing coated Pipes (Hazardous Substances)

7.2. Pipe Welding

All welding, including welder certification and qualification, welding procedure qualification and weld examination and testing is to be carried out in accordance with AS4041 for Pipe Classification Class 2P, except that the minimum extent of non-destructive examination shall be as stated below.

The first 3 joints and one in ten of all remaining joints (whether slip-in, ball and socket or collar) shall have non-destructive examination in accordance with AS 4037 by magnetic particle examination. Penetrant examination is permissible as an alternative to magnetic particle examination only if access restrictions preclude the use of the magnetic particle method.

Weld acceptance levels shall be in accordance with AS 4037 for Class 2 piping.

Slip-in joints are to be welded externally. A complete external weld shall in addition to the circumferential fillet weld include a run on the ground-off weld of the “bell”, the whole comprising a “joint”. The fillet weld leg length shall be not less than 1.25 times the pipe wall thickness.

Ball and socket joint pipes are to be fillet welded both internally and externally. They shall be laid with the test hole in the joint at the top. The fillet weld leg length shall be not less than 1.25 times the pipe wall thickness. After completion of internal and external welding of the ball and socket joint pipes, air at a pressure of 200 kPa shall be applied through the test hole and soap solution applied to both internal and external welds to check for leaks. All leaks shall be repaired to the satisfaction of the Superintendent and the test hole filled with weld metal.

Collar joints are to be welded externally. The two complete external fillet welds, together with the two horizontal butt weld jointing runs in the case of split collars shall comprise a “collar joint”. The fillet weld leg length shall be not less than 1.25 times the pipe wall thickness. Where pipes that are cut on site have FBP coating, the coating shall be cut with a sharp knife to make a neat edge 50 mm clear of the welded joint before removing the coating prior to welding.

7.3. External Coating of Welded Joints

Heat Shrink Sleeves

Welded joints shall be externally coated using heat shrink sleeves. The Contractor shall use only fully trained and experienced personnel for installation of heat shrink sleeves.

Only sleeves recommended by the pipe manufacturer shall be used.

Application procedure shall be as follows:

- Bevel the edges of the FBP coating so that there is a tapered transition of at least 10 mm between the full coating thickness and the exposed steel;
- Remove any corrosion products on the steel and abrade the steel surface (if necessary) to produce a clean, non-corroded, roughened surface; suitable abrasives are emery paper or a steel file;
- Clean the area to be repaired (to be free from dirt, dust and other contaminants) in accordance with the recommendations of the shrink sleeve manufacturer;
- Slightly roughen the FBP coating around the repair for a minimum distance of 100 mm from the edge;
- Solvent wipe the FBP coating with a clean cloth (acetone is a suitable solvent for cleaning);
- Apply the shrink sleeve in accordance with the application procedures of the manufacturer with the exception that the sleeve shall overlap the FBP coating for a length of 100 mm on either side of the coating; note that the specified preheat and post-heat is necessary to ensure satisfactory bonding of the sleeve; a roller should be used to eliminate voids from under the sleeve.

After application the repair area should be tested with a high voltage detector at 15 kV in accordance with AS3894.1.

The repair should be visually inspected to ensure that it is in intimate contact with the pipe and that a bead of mastic has exuded from each end of the sleeve for the full pipe circumference. (If this is not in evidence additional heating is required).

Tape Wrap Coating

The Contractor may ask approval from the Superintendent to use a tape wrap coating as an alternative to the heat shrink sleeve.

Approval will be given if the Contractor can demonstrate that their team members are skilled in the application of the tape wrap system.

The Contractor shall use a tape wrap system recommended by the pipe manufacturer.

Application procedure shall be as follows:

- The steel and coating area shall be clean and dry before application of the primer;
- Using a brush, apply a thin even coat of primer onto the steel and overlapping the parent material by 100 mm;
- Allow the primer to tack dry (10-20 mins);
- Spirally apply the tape to the repair area ensuring a 100 mm overlap of the parent metal. The overlap of layers should not be less than 55% of tape width;
- Spirally apply the outer wrap to completely cover the first layer tape coating. The overlap of layers should not be less than 10% of the tape width;
- Some tension should be applied when applying the tapes to ensure that air voids, wrinkles, etc. are not present after wrapping;
- Continuity test with a high voltage detector at 15 kV in accordance with AS3894.1.

7.4. Welding of Above Ground Pipes

Where welded joint pipes are to be laid above ground, no pipe-laying shall be done until end thrust blocks are 14 days old.

The pipe shall then be laid and the operations timed so that the closure joint shall be welded up at pipe wall temperature of approximately 21^{o}C.

Should the Contractor elect to weld at night to comply with temperature requirements the Contractor must supply sufficient lighting which in the opinion of the Superintendent is necessary for efficient working.

The Contractor will not be permitted to start these sections unless, in the opinion of the Superintendent, the Contractor has assembled sufficient plant to enable compliance with this Specification.

7.5. Internal Pointing

All welded pipe joints for pipes of 500 mm internal diameter and larger, shall be closed internally and the bore made uniform by internal pointing after the welding has been completed.

Mortar for pointing shall consist of a mixture of Portland cement type GP to AS3972, acrylic modifier and sand in the proportion by volume of two parts of sand to one part of cement for pipes up to 750 mm diameter and three parts of sand to one part of cement for 900 mm pipes. The acrylic modifier shall be added to the sand/cement mix until the mortar is stiff but cohesive.

The sand shall be clean, sharp sand complying with AS2758.1. The sand must be free of clay and of maximum size not greater than one third of the lining thickness.

The surface must be free of grease, oil, paint and loose or flaking material.

The adjacent cement mortar shall be wetted one hour prior to repair.

The mortar shall only be applied when the ambient and mortar temperatures are below 30^{o}C.

Any excess water shall be wiped from the area, but the surfaces shall be left damp.

The acrylic modifier shall be applied as a primer to the steel and adjacent cement mortar immediately prior to applying the mortar. This priming coat can be wet or dry when the mortar is placed.

The mortar shall be added in the normal manner, being worked into place and compacted. The mortar is built up to the level of the existing cement mortar.

As the ambient temperature increases the pot life of the mortar is reduced. At 30^{o}C the pot life is approximately 20 minutes. If the mortar is left to stand a skin will develop on the mortar surface. This should be remixed into the mortar before use.

Mortar must be allowed to dry out. Note that this is opposite to that normally required for mortar. The mortar must not be subjected to excessive heat, rain or sub-zero temperatures during the first 48 hours. It is recommended that the mortar dries for 7 days prior to service.

8. Pipeline Valves

8.1. Gate Valves

Gate Valves shall comply with AS 2638 Part 1 for metal seated valves and AS 2638 Part 2 for resilient seated valves and accordance with Unitywater specification Pr9693 - *Specification for Mechanical Installations*.

Spindles for valves, including extension spindles, shall have a torque failure capacity of at least 4 times the torque required to 'crack' the valve.

The information required by Appendix B2 of AS 2638 Part 1 and AS 2638 Part 2 shall be obtained from the Project Specification, Drawings, Schedule of Rates or Bill of Quantities as appropriate.

Some default information is provided as follows, and shall only apply if no other information is provided in the Contract documents. Any information not provided shall be obtained from the Superintendent prior to ordering the valve.

Table 1 - Default Requirements for Gate Valves

Information to be supplied	Default Requirement
Direction of closure	Anti-clockwise.
Design type	Non-rising spindle.
Actuation – Differential pressure	The maximum working pressure for the class of valve.
Special packing requirements	Close the wedge for dispatch.
Witness tests	No.
Additional tests	Scour valves shall be "free end" tested.
Type test certificate	Yes.
Production test certificate	Yes.

8.2. Butterfly Valves

Butterfly Valves shall comply with AS 4795 and accordance with Unitywater specification Pr9693 Specification for Mechanical Installations.

The information required by Appendix B2 of AS 4795 shall be obtained from the Project Specification, Drawings, Schedule of Rates or Bill of Quantities as appropriate.

Some default information is provided as follows, and shall only apply if no other information is provided in the Contract documents. Any information not provided shall be obtained from the Superintendent prior to ordering the valve.

Table 2 - Default Requirements for Butterfly Valves

Information to be Supplied	Default Requirement
Seal	Seal-on-body. The sealing surfaces of the valves shall bed on the metal face of the pipework flanges, not on the cement lining. If the valve sealing surface does not bed on the metal face, the Contractor shall provide minimum 6 mm thick Grade 316 stainless steel insertion rings and additional rubber insertion joint rings.
Shaft	"Through" type.

Information to be Supplied	Default Requirement
End Connection	Flanges shall have raised face. Flanged ends shall comply with AS 4087 unless an alternative flange type is specified. Bolts, nuts and washers shall be stainless steel complying with Clause 3.2 of the standard.
End of pipe isolation	Disassembly of downstream piping with valve closed against rated pressure is required.
Direction of hand wheel closure	Anti-clockwise.
Witness tests	No.
Special packing requirements	Close the disc for dispatch.
Type test certificate	Yes.
Production test certificate	Yes.

Butterfly valves shall be heavy pattern double flanged valves with replaceable resilient seat, disc of aluminium bronze or stainless steel, a one-piece stainless-steel shaft, ductile iron body, corrosion resistant bearings and shaft seals.

The valve shaft shall use the dry shaft principle with self-lubricating bearings and a rigid shaft/disc connection.

The valve shall be fitted with upper and lower bearings.

The valve shall not require routine gland adjustment or lubrication.

The butterfly valves shall be manually or electrically/pneumatically actuated through a totally enclosed lubricated for life gearbox. The gearbox shall be of weatherproof ductile iron construction with carbon steel spur and worm gear, ductile iron segment gear, bronze bushes and ball thrust bearings. The gear box shall have open-shut position indication and shall be suitably proportioned for connection of the actuator or operating spindle. All bolts, nuts and screws including those to cover plates and end cap fixings shall be Grade 316 stainless steel.

8.3. Knife Gate Valves

Knife Gate Valves shall comply with AS 6401 and accordance with Unitywater specification Pr9693 Specification for Mechanical Installations.

The information required by Appendix B2 of AS 6401 shall be obtained from the Project Specification, Drawings, Schedule of Rates or Bill of Quantities as appropriate.

Some default information is provided as follows, and shall only apply if no other information is provided in the Contract documents. Any information not provided shall be obtained from the Superintendent prior to ordering the valve.

Table 3 - Default Requirements for Knife Gate Valves

Information to be Supplied	Default Requirement
Body material	Cast iron, ductile iron or stainless steel.
Blade material	Grade 316 stainless steel.
Seat material	Grade 316 stainless steel.
Fastener material	Grade 316 stainless steel.
Stem material	Grade 316 stainless steel.

Information to be Supplied	Default Requirement
Seal material	The seals shall be of neoprene or better material and shall form a flush surface inside the bore of the valve to discourage an accumulation of debris which may interfere with the seating of the valve.
Application	Bi-directional.
Actuation	Manual with a non-rising spindle. Anti-clockwise rotation for closing.
Body style	Flanged or lugged and drilled and tapped to suit the mating flange bolting. Connection to resist full test pressure if downstream pipe work removed when valve is closed.
Type test certificate	Yes.
Production test certificate	Yes.

Knife gate valves shall not be used in buried applications.

8.4. Check Valves

Flanged check valves shall comply with the requirements of AS 4794 and accordance with Unitywater specification Pr9693 *Specification for Mechanical Installations*.

The information required by Appendix B2 of AS 4794 shall be obtained from the Project Specification, Drawings, Schedule of Rates or Bill of Quantities as appropriate. Some default information is provided as follows, and shall only apply if no other information is provided in the Contract documents. Any information not provided shall be obtained from the Superintendent prior to ordering the valve.

Table 4 - Default Requirements for Check Valves

Information to be Supplied	Default Requirement
Extended spindle	Required.
Micro-switches, counterweights or indicators	A counterweight is required where specified in the design.
Degrees of special transport protection required	Transport protection shall be such that the coating is adequately protected from damage. The flap shall be tied to prevent movement.
Test certificate	Type and production test certificates shall be forwarded to the Superintendent.
Witness hydrostatic test	The Superintendent will not witness the hydrostatic tests.

Wafer check valves shall incorporate a wafer type ductile iron body suitable for installation between AS 4087 (Fig. B5 or B7 appropriate) flanges, grade 316 stainless steel disc, arm and pin assembly material and EPDM seal.

8.5. Hydrant and Air Valve Isolator

Where specified, a hydrant and air valve isolator shall be provided to isolate valves for maintenance purposes. This shall allow access from the top of the valve pit and eliminate the need for the operator to enter the pit.

All Hydrants on trunk water mains shall require isolators.

8.6. Air/Gas Release Valves

Air/Gas Release Valves shall comply with WSA 106 and AS 4883.

Where specified, a Hydrant and Air Valve Isolator shall be provided.

The information required by Appendix B2 of WSA 106 shall be obtained from the Project Specification, Drawings, Schedule of Rates or Bill of Quantities as appropriate.

Some default information is provided as follows, and shall only apply if no other information is provided in the Contract documents. Any information not provided shall be obtained from the Superintendent prior to ordering the valve.

Table 5 - Default Requirements for Air/Gas Release Valves

Information to be Supplied	Default Requirement
Alternative materials	Use basic materials.
Type test certificate	Yes
Production test certificate	Yes

The inflow capacity of large orifice Air/Gas Release valves with 20 kPa differential pressure across the Air/Gas Release valve shall be:

Table 6 - Air/Gas Release Valve Inflow Capacity

Air/Gas Release Valve Size (mm)	Inflow Capacity (L/s of free air)
50	275
80	550
100	1000

Unless otherwise stated Air/Gas Release valves shall be suitable for a Maximum Operating Pressure of 1.6 MPa and an Allowable Site Test Pressure of 2.0 MPa (in accordance with the pressure definitions in AS 2280).

8.7. Spring Hydrants

Spring hydrants shall comply with AS 3952.

Hydrants to have removable top cap and internal assembly to allow direct full bore access to the pipeline for swabbing or flushing.

The information required by Appendix C of AS 3952 is as follows:

- Flange size and the number of this Standard:
  - Flange size shall be DN 100;
- Whether it is intended to witness hydrostatic tests and the extent of those tests:
  - The Superintendent will not witness the hydrostatic tests.

9. Thrust Blocks

The Contractor shall construct thrust blocks of Class N32 (AS 1379) concrete at all bends, horizontal and vertical, tees, plugs, caps, reducers and other locations where there will be an unbalanced hydraulic load in accordance with the relevant SEQ WS&S D&C Code or the Sewage Treatment Facility design documents.

Concrete shall not cover socketed joints or extend outside the water allocation in a footpath location.

Excavations for thrust blocks shall be kept true with the sides vertical and the base horizontal. The Contractor shall place the concrete against excavated ground which must be undisturbed and free of loose or deleterious matter.

Thrust blocks shall be designed for thrusts from the specified test pressure. The Contractor shall engage a Professional Engineer registered to NPER-3 or appropriate State registration, experienced in the geotechnical assessment of soil who shall design all thrust blocks not detailed in the drawings. Details of the design shall be provided to the Superintendent.

10. Embedment

Pipeline embedment shall conform to the requirements of this specification and the relevant SEQ WS&S D&C Code.

11. Trench Fill

11.1. General

For the purposes of this Specification, trench fill is defined as the refilling of trenches/excavations from the top of the pipe overlay (embedment) to ground level in non-trafficable areas and sub-grade level in trafficable areas.

Trench fill shall be in accordance with the relevant SEQ WS&S D&C Code.

The Contractor shall ensure all exposed surfaces of trenches/excavations are uniform and free of excessive gouging, overhangs and cavities to enable uniform compaction of backfill.

The Contractor shall use appropriate methods of compaction to achieve the compaction requirements of the Drawings and the Specification.

Excavation and Backfill under Non-Trafficable Areas

Non-trafficable areas are not included in the above.

Excavation and backfilling under trafficable

Trafficable areas are defined as:

- All excavations with a pipeline centreline within 0.50 m beyond each edge of the existing roadway/pavement area/back of kerb;
- Excavations which are deeper than 3.0 m within 0.70 m beyond each edge of the existing roadway/pavement area/back of kerb;
- Excavations across existing driveway cross-overs, paths in road reserves, public open spaces and paved areas in private properties including 0.50 m beyond each edge of the driveway/path/paved areas;
- Sections of trenches/excavations with the pipe centreline within 2.0 metres of a residence, building or wall.

11.2. Material Requirements (Non Trafficable Areas)

Backfill material suitable for under non-trafficable areas shall be in accordance with WSA PS-363 Trench Fill Materials and WSA PS-365 Recycled Materials for Trench Fill.

Material for backfill under non-trafficable areas shall be excavated material or, where excavated material is unsuitable for backfill, imported suitable material. Excavated material (including clay/clayey soils) shall not be deemed unsuitable due to its moisture content, unless otherwise directed by the Superintendent.

11.3. Material Requirements (Trafficable Areas)

Choose backfill material to suit the permeability characteristics of the surrounding soil to ensure that the completed trench does not hold water nor obstruct existing drainage paths through the soil.

Under Road Carriageways

Granular fill in stormwater drainage trenches or trenches in permeable soils.

Class 3 material or stabilised sand or controlled low strength material or lean mix concrete in trenches where free drainage points are not available or trenches in impermeable soils.

Lean mix concrete in isolated patches less than 2 m^2 in size.

Under Footpaths and Bikeways

Excavated material (in accordance with requirements of Excavated Material below), provided adequate compaction can be obtained. Alternatively use class 3 material or stabilised sand or controlled low strength material or lean mix concrete in trenches where free drainage points are not available or trenches in impermeable soils. Use granular fill or sand in trenches where free drainage points are available or trenches in permeable soils.

Permeability Characterisation

Collect a handful of representative existing trench soil material, discarding particles larger than 10 mm in diameter. Spray a fine water mist evenly throughout the soil particles to achieve the optimum moisture content. Mould the moist sample by hand pressure. The soil material is considered relatively impervious if the moulded sample remains intact after being tossed lightly from one hand to the other. The soil material is considered relatively permeable if there is difficulty in maintaining the moulded shape or the moulded sample crumbles after being tossed lightly from one hand to the other.

Permeable soils are generally coarse grained soils including sand, gravel, sand-gravel mixture.

A soil is of basic type sand or gravel if, after the removal of any cobbles or boulders, over 65% of the material is of sand and gravel sizes.

Impermeable soils are generally fine grained soils including clay, silt, gravelly or sandy clay, gravelly or sandy silt. A soil is of basic type silt or clay if, after the removal of any cobbles or boulders, over 35% of the material is of silt and clay sizes.

Granular Fill

Granular fill for use as trench backfill under roads and other trafficable areas shall be a gravel or decomposed or broken rock, non-plastic open graded material or crusher run recycled concrete, CBR15, free from vegetable matter and lumps of clay with the following properties:

Table 7 - Properties for Granular Fill

Metric	Percent passing by weight (%)
75 mm	100
2.36 mm	25-70
75 μm	0-30

Miniature abrasion loss (passing 2.36 mm sieve) shall not exceed 15%.

For the material passing the 425 μm sieve the following shall apply:

- Liquid limit 0-35;
- Plasticity Index 0-12;
- Linear shrinkage 0-8.

The material retained on the 2.36 mm sieve shall consist of sound stone.

Class 3 Material

Class 3 material shall comply with the following requirements:

Table 8 - Properties of Class 3 Material

Class 3 Material Property	Test method	Soil aggregate
Liquid limit	AS 1289.3.1.1	35% maximum
Plasticity index	AS 1289.3.3.1	12% maximum
Linear shrinkage	AS 1289.3.4.1	6.5% maximum
P.I. x % passing 0.425 mm sieve	-	360 maximum
% passing 0.075 mm sieve % passing 0.425 mm sieve	-	0.30 - 0.65
Soaked CBR (at the specified minimum relative compaction)	AS 1289.6.1.1	15% minimum
Ten percent fines value (wet	AS 1141.22	105 kN. minimum
Resistance to weathering	To pass	

The following materials, produced and controlled to Queensland Department of Main Roads Standard Specification MRS 11.05 Unbound Pavements may be substituted for Class 3 material:

- Type 2 unbound material, subtypes 2.1 or 2.2 or 2.3 or 2.4;
- Type 3 unbound material, subtypes 3.1 or 3.2 or 3.3, provided the soaked CBR is ≥15%;
- Sand: A fine grained material with more than 90% passing 0.425mm sieve may be used as a Class 3 material if the material is of uniform quality; meets the Atterberg limits of (Liquid limit 28% maximum, Plasticity index 8% maximum and Linear shrinkage 5% maximum) and is at least CBR 15 (4 day soaked).

Excavated Material

Well graded inorganic non-perishable material, maximum size 75 mm, plasticity index ≤55%.

Stabilised Sand

One (1) part (either Type GP or Type GB cement) to 12 parts sand (by volume) shall be mixed with a minimum quantity of water sufficient to allow ease of placement and compaction.

Controlled Low Strength Material

An approved proprietary cementitious flowable fill. Provide 28 day compressive strengths of 0.5 - 2.0 MPa under footpaths and 3 - 5 MPa under roads. The material shall be placed by discharging directly from a concrete agitator truck. Alternatively a concrete pump may be used where access is a major problem.

Lean Mix Concrete

28 day characteristic compressive strength of 5 MPa for concrete shall be achieved. Nominal maximum aggregate size of 40 mm shall be used. Target slumps of 80 - 100 mm for wet concrete and less than 15 mm for dry concrete shall be achieved.

Sand

'Sand' shall be natural sand or manufactured sand or a blend of natural and manufactured sand, comprising hard durable particles with the following properties:

Table 9 - Properties of Sand

Property	Natural sand	Blended and manufactured sand
% by weight passing the 6.7 mm A.S. sieve	100	100
% by weight passing the 0.075 mm A.S. sieve	5 maximum	20 maximum
Plasticity index	5 maximum	10 maximum

11.4. Compaction of Trench Fill

Each layer shall be compacted to not less than the specified dry density Ratio (RD) or Density Index (ID). Compaction using jetting or flooding of the fill is not permitted. Following placement, trench fill material shall be compacted in layers to achieve uniform compaction throughout the depth of each layer. The minimum compaction requirements are defined in Table 100.

Determination of compaction shall comply with the following requirements:

- Cohesionless materials shall be determined using density index in accordance with AS1289.5.6.1;
- Cohesive materials shall be determined using standard dry density ratio in accordance with AS1289.5.4.1 based on the field dry density as per AS1289.5.3.2 or AS1289.5.8.1 and the maximum dry density as per AS1289.5.1.1.

Table 10 - Minimum Trench Fill Compaction

	Cohesionless Materials (Density Index)	Cohesive Materials (Standard Dry Density Ratio)
Non- Trafficable Areas	60	90
Trafficable Areas	70	95

Non Trafficable

Backfill and compacted shall be placed in layers not exceeding 300mm loose thickness for cohesive materials or 600mm loose thickness for cohesionless material.

The top 200mm of backfill material in grassed and garden areas shall be the topsoil removed during the stripping operation and shall be compacted to the density of the surrounding topsoil.

Trafficable Areas

Trafficable areas shall be placed at optimum moisture content +/- 2% in layers not exceeding 200 mm loose thickness.

11.5. Provision for Settlement

Through other than pavements, lawn areas or other improved surfaces, trench fill shall be placed sufficiently high to compensate for expected settlement. Any settlement shall be made good during the Defects Liability Period and at the end of the Defects Liability Period, trim back any excess material to conform to the adjacent surface.

Where reasonable convenience of persons requires trenches to be levelled off at the time of filling, any subsequent settlement shall be made good as necessary by placing and compacting additional fill.

11.6. Concrete Encasement

The Contractor is to provide all materials for concrete filling to trenches where required for the protection of pipes across streams, gullies or depressions. The minimum thickness of concrete filling shall be 150 mm. Concrete filling is to be provided where shown on the drawings unless otherwise directed by the Superintendent.

The Contractor shall construct concrete bedding and encasement in accordance with SEQ WS&S D&C Standard Drawing No. SEQ-WAT-1204.

The Contractor shall ensure that pipes do not move, float or deform while pouring concrete.

PVC-O and PVC-M pipe shall not be used where concrete encasement is required. In such cases, ductile iron or mild steel pipes shall be employed.

The bottom of the trench shall be clean, sound and drained to the satisfaction of the Superintendent prior to concreting. Pipes may be temporarily supported on concrete chairs to maintain line and grade during concreting.

Rubber ring joints shall be wrapped with mastic filler cord prior to encasement and a flat fibre cement insert shall be provided to give a complete break in the surround at every pipe joint. This break shall be located as follows:

- For MSCL, DI pipes and PVC pipes: on the socket within 25 mm of the end of the socket;
- For GRP pipes: on the coupling within 25 mm of the end of the coupling;
- At the ends of the concrete filled trench, the following pipe arrangements shall be provided:
    - For MSCL, DICL, PE and PP pipes: a flexible joint shall be provided; the location of the joint shall be as close as possible to the concrete consistent with making the joint;

- For PVC, ABS and concrete pipes: a socket end shall be cast into the concrete such that the end of the socket is flush with the end of the concrete;
- For GRP pipes: a coupling shall be cast into the concrete such that the outer edge of the coupling projects no more than 25 mm from the concrete.

Where differential settlement is anticipated, a second flexible joint shall be provided. This joint shall be 0.6m from the joint near the concrete filling for PVC, ABS, PE and PP pipes and 1.5m for MSCL, DICL, concrete and GRP pipes.

Concrete for filling of trenches shall be Class N20 to AS 1379.

12. Construction Finishes

12.1. Grouted Stone Pitching

Stone pitching requirements shall conform to the requirements of the Job Specification and Unitywater's Specification for *Civil and Earth Works* (Pr9902)

12.2. Concrete Bulkhead Construction

Details for concrete bulkhead construction are shown on SEQ WS&S D&C Standard Drawing SEQ-WAT-1209-1. Bulkheads are designed to provide support to pipelines constructed at grades between 15 and 30% and at road crossings.

The bulkheads shall be placed immediately behind the socket of the pipes.

13. Acceptance Testing of Pressure Mains

13.1. General

Acceptance testing of pressure pipelines shall be undertaken in accordance with the relevant SEQ WS&S D&C Code or the Sewage Treatment Facility design documentation to ensure all parts of the project, including material manufacture, design and installation have been carried out in accordance with the codes and specifications. The Contractor shall ensure that the appropriate inspections and testing are carried out for all aspects of the project.

Sewage treatment facility pipeline pressure testing should be in accordance with the design documents.

Pressure testing shall be completed using clean potable water for water mains and recycled water for sewerage pressure mains. Where recycled water is not feasible for testing purposes, potable water may be approved for use by the Principal. All tests shall be carried out under the supervision and in the presence of the Superintendent.

Filling of water mains shall be in accordance with Unitywater's approved job plan for Charging of Water Main, utilising the project specific methodology. Where air entrapment is likely due to the pipe profile, filling may be carried out with foam pigs in a continuous manner at a velocity of 1-3m/s to expel air. Should the line include fittings or valves which are unable to safely pass a pig, Contractors are to submit dispensation and provide alternative methodology ensuring no risk of significant air entrapment. Stopping or shunting of pigs shall be avoided at all times. If pigs are to be stopped for a period of time it is advised to do it on a section with a positive gradient to avoid increased air entrapment.

For Horizontal Directional Drilled (HDD) and PE pipelines installed within an Enveloper, the welded pipe string shall be field tested to the same hydrostatic pressure test applied in the aboveground and belowground condition. For PE pipelines used for trenchless installation, testing is to be carried out above ground prior to any trenchless install and in accordance with AS 2566 Part 2 M8 for a period of 1 hour.

Hydrostatic pressure testing shall be undertaken by a NATA accredited testing authority. The hydraulic test shall be carried out as soon as possible after laying and jointing, or in lines with thrust blocks, not less than fourteen (14) days after thrust blocks are cast. Any temporary end caps/thrust blocks shall be removed at the completion of a satisfactory test procedure.

Minimum test heads required for pipelines at the lowest point of each section of pipe shall be in accordance with the relevant SEQ WS&S D&C Code unless noted otherwise on the drawings.

Gravity Water Supply Mains are defined as all pipework upstream of the pump station. The point of delineation between pressurised and gravity mains shall be at the pump sets and the non-return valve on the bypass line around the pump station.

The installed pipeline shall not be considered as completed and accepted until the pressure test has been successfully completed.

In addition to the requirements of the above clause, there shall be, during the test, no noticeable leakage or sweating at joints, nor other defects in the Contractor's work. Any such defects must be repaired by the Contractor and the test repeated until the Superintendent is satisfied that the whole of the work is tight and sound.

Pressure testing against valves should be avoided where possible.

Where pressure testing against a valve cannot be avoided, suitability of the valve for pressure testing purposes is to be investigated and must be approved by the Unitywater Project Manager prior to testing.

Pressure testing against closed valves shall not be undertaken unless the valves are fully restrained and it is possible to check for leakage past the valve seat.

Upon completion of pressure testing, the Contractor shall provide Pressure Test Certificates to the Superintendent for approval.

13.2. Testing PE pipeline

Pressure testing equipment

Pressurisation pumps shall be diesel only and have a sufficient flow rate capable of reaching test pressure in less than 2 hours.

Pressure gauges shall be digital test grade gauges either Crystal XP2i or equivalent and calibrated within 1 year as per NATA calibration interval requirements. A minimum of 2 digital pressure gauges shall be used on each test with a 5-minute logging interval. Logging shall begin once the pressure pump is connected and prior pressurisation has started. Industrial gauges shall only be used as indicative values and not for recording purposes. Pipelines under pressure shall never be left without a gauge at each exposed section.

Flowmeters shall have a 5-point calibration check within 2 years as per NATA calibration interval requirements with water as the test medium. Flowmeters shall have an accuracy ≤ ±2% of readings at the flowrates relevant to pressurising the test section. A strainer shall be used in order to ensure the flowmeter is protected with the mesh size selection at the contractor’s discretion.

Pressure Safety Valves (PSV) are to be installed on the test section. PSV’s shall be wired, tagged with set pressure engraved and fitted prior to pressurisation. Set pressure shall be 100kPa above test pressure. PSV calibration certificate shall be provided prior to use. A valve may be installed under the PSV however valve position is to be confirmed prior to testing. PSV sizing selection shall be able to discharge pressure faster than can be input via the pressure pump to protect the pipeline from over pressurisation.

Temperature measurement shall be limited to ambient temperature only. Ambient temperature measurements shall be taken in the shade and avoid direct sunlight.

All flexible hosing shall have their MAOP marked and in good working order. The flexible hosing MAOP shall not be less than the set pressure of the PSV. All flexible hosing shall be fitted with either whipsocks or whipchecks which are to be secured or taped to the connecting hose and/or fittings with no slack to reduce risk in the event of a rupture.

All test fittings shall be marked with an MAOP and shall be not less than twice the set pressure of the pressure relief device. Cast iron fittings shall not be used.

All test fittings, blinds and valves shall be plugged. Valves shall placed into the ½ position where appropriate. Valves shall have appropriate valve handles or removed from use on the test section and associated equipment. If a valve handle is to be removed overnight it shall be in the ½ position, plugged, tagged and reinstated when safe to do so. Temporary Valves shall not be adjusted with hand tools.

Test manifolds shall be suitably rated for the test pressure. Manifolds shall be free of air entrapment prior to commencing testing to avoid influencing test instruments.

Testing personnel shall be responsible for ensuring all temporary equipment, fittings and instruments are suitably rated for the test pressure and in good working condition.

Pressure shall be able to be controlled from the pressure source and isolated if required. No active pumps shall be unattended during any pressure testing activities.

Pressure Testing Documentation

A testing procedure shall be submitted, reviewed and approved in advance of any testing activities being performed. This is to include documentation provided by the NATA accredited testing facility performing the testing activities. The testing procedure must be specific to the project and not a generic document.

The approved pre-test calculation values shall reflect as-built data. Initial calculations are to reflect design data provided.

Test limits are to be marked on relevant drawings with limits flagged, section highlighted, identification of removed items and any additional information concerning the test section.

Exclusion zone calculations are to be as per AS 3788 are to have an assumed value of 0.2% air entrapment if the system can be effectively bleed free of air. Should the system have expected areas in which air entrapment is known then a suitable value is to be determined by the NATA testing authority. This shall be reflected in the test procedure, risk assessment and other relevant data. It also should be noted that it may impact test results and acceptance.

Test procedures are to include but not limited to methodology for filling, air removal, testing location, safety measures, test method and acceptance criteria.

Each test section shall have a separate test pack and test pack number. Test pack documentation shall include but not limited to marked up as-built drawings, exclusion zone calculations, pre-test acceptance calculations, calibration records.

NATA Test reports shall be in accordance with the requirements of AS 2566 Part 2.

Pressure Testing Performance

Personnel carrying out the test shall have a field copy testing procedure and test pack with them prior to any works. Limits of the test are to be walked and valve positions verified prior to commencing works.

Any pigs in the test section shall be removed prior to testing.

Initial pressurisation shall be conducted in 25% increments with 5 minute stabilisation at each interval. Testing personnel shall confirm there are no leaks on exposed sections at 25% and 50% of test pressure. Pressurisation and depressurisation rates shall be managed in a controlled manner and avoid sudden or large pressure changes.

For PE being tested to AS 2566 Part 2 M5 the initial pressurisation prior to 12-hour stabilisation may be held for an extended period at the test controller's discretion. This is to reduce the level of uncertainty due to the effects of creep associated with PE and allow for identification of any potential leaks or concerns.

Pressurisation during any test period in accordance with AS 2566 Part 2 shall be carried out in a consistent manner to ensure continuity of measurements and results.

Should a test be unsuccessful the root cause shall be investigated prior to performing additional works. If a leak is believed to exist, the pipeline is to be divided into sections via inline valves. Pressure is to be equal both sides of the closed valve and pressure decay compared.

Upon completion of the test, pressure shall be reduced to 0kPa at the high point unless directed by Unitywater. Care shall be taken to prevent the system experiencing a negative pressure post-test.

Care shall be taken with larger system volumes to ensure that pressure fluctuations create minimal influence upon the instrument measurements when removing air and may take longer to stabilise.

Pressure Testing Safety

Test sections shall be adequately flagged with danger signage at all exposed sections when under pressure set at the relevant exclusion zone distance. Pressure gauges shall be fitted at exposed sections where appropriate. Contact details are to be posted at exposed test locations of the test controller and/or representative.

Exclusion zone calculations shall be provided prior to works commencing and distances communicated with all parties involved. Exclusion zones apply to the entirety of exposed pipe sections or strings. Measures shall be taken to ensure that line of fire for fittings and hoses do not pose additional risks to personnel, civilians or property in the local area.

During testing, no personnel or equipment shall stand in the line of fire or inside the exclusion zone. Sufficient hose length shall be used to ensure that instrumentation is outside of the exclusion zone.

Communication between test controller and personnel is to be free and clear of congestion. Pressurisation shall not be conducted without the knowledge of all relevant parties, safety documentation and consent of Unitywater.

Air shall be removed from the test system as much as possible through bleed valves with water discharge into an appropriate location advised by Unitywater. All risers and high points shall be vented of air. Any section suspected of potential air entrapment shall be assessed and relevant controls implemented.

Once pressurisation has begun no additional work or adjustments are to be made on the test section until pressure has been reduced to system head pressure. This is including but not limited to tightening fittings, flanges or fixing any leaks.

Upon reaching 75% of test pressure and no leaks have been identified, non-essential personnel are to remain clear of the test section at the relevant exclusion zone distance. Additional inspections may be carried out after the first 1 hour of testing has passed with the permission of the test controller. It is advised not to touch any pipework or joints under pressure when carrying out inspections.

Sections previously tested may have exclusion zones reduced if requested, with the approval of Unitywater. Any exclusion zone reduction shall be noted in the relevant documentation and a risk assessment performed. If previously tested to a lower pressure no exclusion zone reduction is applicable.

Standing on, driving over, moving or adjusting flexible hosing whilst under pressure shall be avoided as it may invalidate instrument readings and impact the test records. Hosing shall be positioned to maintain good housekeeping practices. Should a flexible hose be disrupted during test it is to be noted on the testing sheet with the time of the event.

13.3. Compaction Acceptance Testing

Compaction acceptance testing shall be in accordance with the relevant SEQ WS&S D&C Code.

The Contractor shall conduct compaction trials, in the presence of the Superintendent, to demonstrate that the proposed compaction methodology meets the requirements of this Specification. These trials shall cover each diameter of pipe on the project and shall be performed to the Superintendents satisfaction prior to pipe laying.

The Contractor shall undertake compaction trials where the material does not conform to the embedment or fill specification or where changes occur in the compaction procedure or the material supply.

The Contractor shall use direct methods of measurement to control compaction, except where indirect methods enable appropriate correlations with the soil moduli are permitted.

The Contractor shall engage an approved body accredited by NATA for the particular tests to be undertaken.

Indirect compaction control measures include the dynamic cone penetrometer, Perth sand penetrometer and Clegg impact soil tester. Indirect methods of measurement may be considered where access is difficult or unsafe.

13.4. Disinfection

Before any pipelines are taken over by the Superintendent, the Contractor shall clear them by flushing with clear water.

Under normal conditions, pulling an appropriate device through the pipeline to remove any material deposited there during construction is not necessary.

For water mains, disinfection and water quality testing shall be in accordance with SEQ WSA03-2011-3.1 Appendix 'I' Disinfection of Water Mains, Water Quality Compliance Specification.

The Contractor shall remove flushing water from the pipe system in accordance with *Water Services Association of Australia (WSAA) Guideline: Dechlorination of Drinking Water to Discharged Waterways, National Guidance for the Urban Water Industry 2019*.

Disinfection testing shall be undertaken by a NATA accredited testing authority.

13.5. As constructed Asset Information

As constructed asset information shall be in provided accordance with the Job Specification and the SEQ WS&S D&C Asset Information Specification.

13.6. Water Quality Commissioning and Testing (Water Mains only)

For water mains, the Contractor shall utilise Unitywater's *Pr9032 - Procedure for Managing Water Quality During Mains Commissioning* as the basis for the process of commissioning water mains in order to manage public health risks in accordance with Unitywater's approved Drinking Water Quality Management Plan (DWQMP).

At the completion of the flushing of the disinfection water, the system shall be sampled by a NATA accredited laboratory and tested by a NATA accredited laboratory approved by the Superintendent.

Mains will only be connected to Unitywater's network when the contractor has provided the signed and completed *F10045 - Water Quality Mains Commission Form;* and relevant *Work Permit (refer Pr8996 - Network Permit to Work Procedure)* has been approved.

14. Restoration and Finishing Works

14.1. Backfilling of Excavation

No trenches shall be backfilled until the lines have been visually inspected, construction details recorded, the Superintendent or his representative has carried out his audit inspections and permission given by him for filling to commence.

Backfilling of pipe trenches shall be undertaken in accordance with the specification and the *relevant* SEQ WS&SD&C Code.

Excavated material which is surplus to the requirement for filling shall be removed from the site and disposed of at an approved waste disposal facility.

Should suitable backfill material be unavailable from the material excavated from the site of the works, the Contractor shall, following the approval of the Superintendent in writing, use imported filling.

The material used for backfilling shall be carefully replaced in such a manner as to leave no cavities or voids. Particular care must be taken not to allow any large pointed stones or other hard and unyielding material to be placed immediately above the pipe surround. The finest material must be used for 300 mm above the sand.

Care shall be taken when backfilling that the surface shall be left in such a condition that it will not erode as the result of surface water passing over it.

Where trench shoring has been used during excavation the Contractor shall exercise particular care in its removal during the backfilling operation. The Contractor shall not remove the shoring in such a way that the sides of the trench are permitted to fall or voids are left in the backfilled material.

The Contractor shall take adequate measures to prevent flotation of the pipeline due to groundwater or inundation before completion of the backfilling. Any length of pipeline, where flotation has occurred, shall be removed from the trench, carefully inspected for damage and re-laid.

Where excavation is in tunnel the refilling shall be with bedding material compacted by flooding with water or immersion vibration.

The backfilling of excavation under railway lines shall be carried out in accordance with the conditions set down for the construction of such lines.

The backfilling of excavation under main roads or important Council roads where special treatment is required shall be carried out in accordance with the relevant road Authorities current standard.

14.2. Restoration of Surfaces

All surfaces shall be restored in such a manner that they conform generally to the levels, grades and types of surface material existing before the work was commenced. Restored surfaces shall be maintained in such a way as to avoid any hazard or inconvenience. In private properties, routes of normal access shall be restored to a safe and trafficable condition by the close of work each day.

Garden soil shall be replaced to a maximum depth of 300 mm during backfilling with material approved by the Superintendent as equivalent to that removed.

In grassed areas, the top 150 mm of the backfilling shall be carried out with material approved by the Superintendent as equivalent to that removed. Where turfs have been removed, they shall be replaced on this material and top dressed.

Areas affected shall be cleared up, the surfaces made good and all surplus materials carted away.

All improvements on premises which have been damaged by the Contractor shall be made good or replaced so as to be the equal of those existing before the Contractor's operations. Where infrastructure on private premises cannot be restored within two (2) days, it shall be re-erected to the satisfaction of the Superintendent in a temporary location until such time as permanent restoration can be carried out, unless agreed otherwise with the occupier.

All restoration work shall be to the satisfaction of the Superintendent. Initial cleaning up shall be carried out as soon as backfilling is completed and restoration in private premises shall be completed within seven (7) days after backfilling. Beyond this time the Superintendent may arrange to have the work carried out at the Contractor's expense.

The Contractor shall, from time to time, as required, provide and place any pavement material, topsoil or other material that may be necessary to make good any subsidence and shall ensure that the restored surfaces are maintained throughout the duration of the Contract in conformity with the level of the adjoining surfaces to allow the safe and convenient passage of traffic.

The Principal may require that designated areas receive special restoration using any one of a number of special techniques which are available. These may include re-seeding, turfing, hydraulic seeding and mulching and may include provision for the protection of newly restored surfaces using fibre matting.

The choice of restoration technique must be made prior to completion of clearing and stripping activities, taking into consideration:

- The pre- construction and post-construction landform of both the immediate construction area and that adjacent to the construction site – on steep slopes hydro mulching or turf application is the preferred approach and the restoration area must, after its establishment period blend seamlessly into the surrounding area;
- The type of pre-clearing and pre-stripping vegetation in both the immediate construction area and that adjacent to the construction site – wherever possible vegetation is to be restored in keeping with the pre-construction landscape;
- A preference for hydro mulching on steep slopes, large land areas, areas where laying or maintaining turf represents a challenge (e.g. 'disconnected' areas along a construction corridor, access by watering truck difficult/restricted);
- A preference to use turf in areas where there is a need for quick, well established grass cover such as within residential developments, along footpaths, parks with (uncontrolled) public access and other public access areas with a high trip risk and in high erosion risk areas;
- Where turf has been used in the restoration, ensure there is a well prepared and scarified sub-grade (i.e. sandy loam topsoil) and where necessary, roll the laid turf to enable adequate contact with the subgrade. The turf should be even with the ground and with no undulations. The edge of the turf patch should be made flush with the surrounding 'non-turfed' areas and 'feathered out'. Topsoil and an approved seed mix may need to be used where top dressing is required, particularly on the edges of the turf patch and/or where gaps between the turf strips are visible;
- Where hydro mulch or turf has been used in the restoration, necessary implementation of a watering regime that ensures watering occurs as necessary (having due regard to local weather conditions) and consistently to attain established root structures and uniform ground cover for a period of no less than twelve (12) weeks;
- Where hydro mulching or seeding is to be used in the restoration, seasonal and weather conditions are to be considered in making the choice of seed mix and time of application (so as to provide greatest success of establishment), additional binders required on steeper slopes and use of Australian native seed mix in areas within and adjacent to areas of regional ecosystem significance.

For areas nominated by the Principal to be re-seeded, the Contractor shall remove the top 100 to 150 mm of sand and/or soil including vegetable matter and stockpiled for later re-use. On completion of backfilling the material removed in accordance with the preceding operation shall be spread uniformly over the disturbed area and covered with a slight cover of topsoil to minimise wind erosion and leaching out. The whole of the disturbed area shall then be seeded with an approved mixture of grass seeds and fertilizer including trace elements suitable for the locality.

The approved mixture shall be spread at the rate of not less than 2.9 kg per 100 m^2. The mixture shall be lightly raked in and the whole area immediately hand watered. Watering in compliance with the local government regulations shall then be carried out until the grass is well established.

For areas nominated by the Superintendent to be turfed, the surface of the backfilled trench and adjoining area shall be raked smooth at a depth of 75 mm below the required finished surface level.

The turfs shall be of *cynodon dactylon* (green couch) or other approved grass suitable for the locality. The grass shall be of good quality free from paspalum, nut grass, oxalis and other weeds.

Turfs shall be cut 300 mm wide x 3 m length (approximately) and 50 mm - 60 mm thick. Turfs shall be cut and delivered to the site so as to minimise time between delivery and laying. If necessary, the turfs shall be stacked, well-watered and protected from the sun. All rolls of turf shall have the grass facing inwards.

A sample of 2 square metres of turf shall be submitted to the Superintendent at least one week prior to the commencement of laying of turfs. If approved, all turfs shall be of at least equal quality. If rejected, further samples from different sources shall be submitted, until an approved source is found.

For areas nominated by the Superintendent, the Contractor shall use hydraulic seeding and mulching (referred to as hydro mulching). Only qualified personnel with a proven ability to apply hydro mulching treatment shall be employed by the Contractor to perform this work. The Contractor shall submit to the Superintendent documentary evidence listing similar projects satisfactorily completed together with a statement of the qualifications and/or experience of the personnel to be employed on the works.

Seed, fertiliser, wood-fibre mulch, water and binder shall be thoroughly mixed together to provide a slurry and shall then be applied under pressure on to the area to be treated by means of hydro mulching equipment specifically designed for this purpose.

Prior to spraying the slurry, the Contractor shall cover the area to be treated with topsoil to a depth of 75 mm. Spraying of the slurry shall be carried out as soon as possible after topsoiling, but not later than 2 weeks. The topsoiled area shall first be watered with a fine water spray to thoroughly moisten the soil to a depth of at least 25 mm without inducing any erosion. Spraying of the slurry shall then take place while the topsoil is still moist.

After the slurry has been sprayed any further watering as ordered by the Superintendent will be paid for at the tendered rate per kilolitre. Application rates for south-east Queensland shall be as listed in the following table. The Contractor shall submit alternative mixes to the Superintendent for approval for areas with different climatic conditions.

Table 11 - Materials for Hydro mulching

Material	Rate of Application	
A. Wood-fibre Defribrated pinus radiata dyed green	2.5 tonne/ha	
B. Binder Anionic bitumen emulsion 50/50 bitumen/water *or* Polymer Binder	1000-2000 L/ha Max.250 L/ha	
C. Certified seed	Summer Mix	Winter Mix
Primary Cereal Cover Japanese millet Perennial rye grass	 25 kg/ha 40 kg/ha	
Secondary Grass Cover Green couch Rhodes grass	 15 kg/ha 15 kg/ha	 25kg/ha 15 kg/ha
D. Fertiliser Type to be approved by the Superintendent	250-400 kg/ha	

Summer shall be defined as from October to March inclusive. Winter shall be defined as from April to September inclusive.

Areas to be protected against erosion during the establishment of the grass cover shall be covered with a heavy duty fibre mat. The heavy duty fibre matting erosion control blankets (such as Enviromat, coir/jute mat or similar approved by the Superintendent) shall be supplied and laid to the manufacturer's recommendations.

15. Appendices

Appendix A – Definitions/Acronyms

The following definitions, abbreviations and acronyms are used throughout this specification.

Term	Meaning
5C's	Acronym for water hygiene practices supporting the protection of drinking water quality
ABS	Acrylonitrile Butadiene Styrene
AS	Australian Standard
ASS	Acid Sulphate Soil
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWWA	American Water Works Association
BS	British Standard
BSPT	British Standard Pipe Thread
Construction	Any work necessary for the installation, testing and commissioning of a pipeline, maintenance hole or house drain. The term shall include such operations as taking care of existing assets, clearing, excavation, erosion control, bedding, laying, jointing, backfilling, restoration, forming, concrete placing, vibrating and stripping, pressure testing and quality testing.
CPVC	Chlorinated Polyvinyl Chloride
CSPP	Carbon Steel Polypropylene
DFT	Dry Film Thickness
DICL	Ductile Iron Cement Lined
DIN	Deutsches Institut für Normung
DN	Nominal Diameter (Number) (mm)
DRG	Drawing
ECTFE	Ethylene chlorotrifluoroethlyene
EPDM	Ethylene Propylene Diene Monomer
ERW	Electric Resistance Weld
FBE	Fusion Bonded Epoxy
FBP	Fusion Bonded Polyethylene
GR	Grade
GRP	Glass Reinforced Plastic
HDPE	High Density Polyethylene
ID	Inside Diameter
ISO	International Organisation for Standardisation
Loose Flange	Product name Uni-flange. A loose flange where restraint is provided by set screws locking onto the host pipe and a special gasket seal.
MAOP	Maximum Allowable Operating Pressure

Term	Meaning
Materials	Any raw or manufactured materials or goods. This includes all machinery, equipment, and components.
MPVC	Modified Polyvinyl Chloride
MSCL	Mild Steel Cement Lined
OD	Outside Diameter
PE	Polyethylene
PIPA	Plastics Industry Pipe Association of Australia
PN	Nominal Pressure (Number) (bar)
PP	Polypropylene
PSV	Pressure Sustaining Valve
PTFE	Polytetrafluoroethylene
PVC	Polyvinyl Chloride
PVDF	Polyvinylidene fluoride
QGTTM	Queensland Guide to Temporary Traffic Management
Sch	Schedule
SI	International System of Units
SS	Stainless Steel
Superintendent	As defined in the General Conditions of Contract called up in the Contract document (such as 2124-1992 or AS 4000) – the Unitywater employee authorised to issue instructions to contractor(s).
UHMWPE	Ultra High Molecular Weight Polyethylene
UNO	Unless Noted Otherwise
UPCIC	Under Pressure cut in connection (also called “under pressure tapping” or “under pressure tee & valve”)
UPVC	Unplasticised Polyvinyl Chloride
Vacuum excavation	Excavation using equipment designed to use water or air pressure to loosen soil and other materials and a vacuum to remove it.
WPQ	Weld Procedure Qualification
WPS	Weld Procedure Specification
WQ	Weld Qualification
WSAA	Water Services Association of Australia

Appendix B – References

General

All design, equipment and workmanship shall conform to the most recent requirements of relevant local, State and Commonwealth statutory requirements and applicable, current Australian Standards.

In the absence of relevant SEQ WS&S D&C Code, WSAA or Australian codes or standards, relevant industry, international (ISO), European or British standards shall be followed. International standards shall take precedence over European or British standards.

Where conflict exists between different Codes, Standards or Regulations, the higher requirement shall apply.

Applicable Legislation and Regulation

The following legislation and related regulation shall apply at a minimum:

- *Work Health and Safety Act 2011* (Qld);
- *Work Health and Safety Regulation 2011* (Qld);
- *Water Supply (Safety and Reliability) Act 2008* (Qld);
- *Environmental Protection Act 1994* (Qld);
- *Queensland Building and Construction Commission Act 1991* (Qld).

Codes of Practice (ratified by Legislation)

At least the following Codes of Practice ratified by legislation shall apply:
SEQ Water Supply and Sewerage Design and Construction Code including:

- SEQ WSA 01 – Polyethylene Pipeline Code;
- SEQ WSA 03 – Water Supply Code of Australia;
- SEQ WSA 04 – Sewage Pumping Station Code of Australia;
- SEQ WSA 07 – Pressure Sewer Code of Australia;
- SEQ IPAM List (SEQ approved Infrastructure Products and Materials List);
- SEQ Asset Information Specification;
- SEQ WSA03-2011-3.1 Appendix 'I' Disinfection of Water Mains, Water Quality Compliance Specification.

*The SEQ Water Supply and Sewerage Design and Construction Code (*SEQ WS & S D & C Code) *is available via the SEQCODE website:* www.seqcode.com.au

Codes of Practice (not ratified by Legislation)

At least the following Codes of Practice shall apply:

- Acid Sulfate Soil (ASS) National Management Guideline;
- Queensland Guide to Temporary Traffic Management (QGTTM);
- Plastics Industry Pipe Association of Australia (PIPA) standards and technical notes;
- Dechlorination of Drinking Water to Discharged Waterways, National Guidance for the Urban Water Industry 2019;
- Water Quality Australia Guidelines.

Relevant Unitywater documents that relate to this specification:

Document No.	Title
Civil & Structural	
Pr9902	Specification for Civil and Earth Works
Pr9903	Specification for Building and Structural Works
Commissioning & Handover	
Pr11211	Specification for Commissioning and Handover of Active and Passive Assets
Pr9085	Pressure Testing of Sewer Rising and Gravity Mains Work Instruction
Pr9087	Pressure Testing of Water Mains Work Instruction
F8917	Worksheet – Overflow and Emergency Storage
F8940	Check Sheet Template Overflow and Emergency Storage
F8941	Check Sheet Template PRVs
F8943	Check Sheet Template SPSs;
F8945	Check Sheet Template WPSs;
F8922	Worksheet – PRVs
F8924	Worksheet – SPSs
F8927	Worksheet – WPSs
Conveyance	
Pr9787	Specification for Microtunnelling and Pipejacking Construction
Pr9788	Specification for Horizontal Directional Drilling (HDD) Construction
Pr9789	Specification for Auger Boring
Pr9790	Specification for Pipe Ramming
Pr9825	Specification for Shafts
Pr10179	Specification for Water Supply Temporary Bypass
Pr11034	Specification for Trunk Water Mains Design and Construction
Mechanical	
Pr9693	Specification for Mechanical Installations
Safety in Design	
Pr8187	Safety in Design Procedure
Pr10883	Safety in Design Guidelines
Water Quality	
F9785	Water Hygiene Field Guide (5C's)
F10045 -	Water quality mains Commissioning form
Pr9032	Procedure for Managing Water Quality During Mains Commissioning
Water meters	
Pr10068	Specification for Water Meters

International and Australian Standards referenced within this specification:

Standard	Title
Quality Systems	
AS 2990	Quality Systems for Engineering and Construction Projects
AS 3901	Quality Systems for Design/Development, Production, Installation and Servicing
AS 3902	Quality Systems for Production and Installation
AS 3903	Quality Systems for Final Inspection and Test
Materials and Workmanship	
AS 1074	Steel tubes and tubulars for ordinary service
AS 1141	Methods for Sampling and Testing Aggregates
AS 1163	Structural steel hollow sections
AS 1281	Cement mortar lining of steel pipes and fittings
AS 1289	Method of testing soils for Engineering Purposes
AS 1477	PVC pipes and fittings for pressure applications
AS 1554.1	Structural Steel Welding, Part 1 Welding steel structures
AS 1579	Arc Welded Steel Pipes and Fittings for Water and Waste Water
AS 1627	Metal finishing - Preparation and pre-treatment of surfaces Part 4 - Abrasive blast cleaning of steel
AS 1646	Elastomeric Seals for Waterworks Purposes
AS 1650	Hot-dipped galvanised coatings on ferrous articles
AS 1830	Iron castings – Grey cast iron
AS 2032	Code of Practice for Installation of UPVC Pipe Systems
AS 2033	Installation of Polyethylene Pipe Systems
AS 2129	Flanges for pipes, valves and fittings
AS 2280	Ductile iron pipes and fittings
AS 2544	Grey iron pressure fittings
AS 2566.1	Buried flexible pipelines – Structural design
AS 2566.2	Buried flexible pipelines - Installation
AS 2638.1	Gate Valves for Waterworks Purposes – Metal seated
AS 2638.2	Gate Valves for Waterworks Purposes – Resilient seated
AS 2758	Aggregates and rock for engineering purposes
AS 3518	Acrylonitrile Butadiene Styrene (ABS) compounds, pipes and fittings for pressure applications.
AS 3571	Plastics piping systems, Part 1: Glass-reinforced thermoplastics (GRP) systems based on unsaturated polyester (UP) resin - Pressure and non-pressure drainage and sewerage
AS 3600	Concrete structures
AS 3678	Structural steel – Hot-rolled plates, floor-plates and slabs
AS 3679	Structural steel – Hot-rolled bars and sections

Standard	Title
AS 3680	Polyethylene Sleeving for Ductile Iron Pipelines
AS 3681	Guidelines for the Application of Polyethylene Sleeving to Ductile Iron Pipelines and Fittings
AS 3690	Installation of ABS Pipe Systems
AS 3706	Geotextiles – Methods of test
AS 3725	Loads on buried concrete pipes
AS 3894.1	Non-Conductive Coatings – Continuity Testing – High Voltage (Brush) Method
AS 3952	Water Supply - Spring Hydrant Valve for Water Works Purposes
AS 3903	Quality Systems for Final Inspection and Testing
AS 4020	Testing of products for use in contact with drinking water
AS 4037	Pressure Equipment – Examination and Testing
AS 4041	Pressure Piping
AS 4058	Precast concrete pipes (pressure and non-pressure)
AS 4087	Metallic flanges for waterworks purposes
AS 4129	Fittings for polyethylene (PE) pipes for pressure applications
AS 4130	Polyethylene (PE) pipes for pressure applications
AS 4139	Fibre-reinforced concrete pipes and fittings
AS 4158	Thermal-bonded polymeric coatings on valves and fittings for water industry purposes
AS 4321	Fusion Bonded Medium Density Polyethylene Coating and Lining for Pipes and Fittings
AS 4373	Pruning of Amenity Trees
AS 4441	Oriented PVC (PVC-O) pipes for pressure applications
AS 4765	Modified PVC (PVC-M) pipes for pressure applications
AS 4794	Non-return valves for waterworks purposes – swing check and tilting disc
AS 4795	Double flanged butterfly valves for water works purposes
AS 4853	Electrical hazards on metallic pipelines
AS 4883	Air valves for sewage
AS 4799	Installation of underground utility services and pipelines within railway boundaries
AS 6401	Knife gate valves for waterworks purposes
DIN 8077	Polypropylene (PP) pipes – dimensions
DIN 8078	Types 1, 2 and 3 polypropylene (PP) pipes – General quality requirements and testing
DIN 16962	Parts 1-10 Pipe joints and elements for polypropylene (PP) pressure pipes